SERVICE MANUAL

Rolex 28-7

SER. NO. HY2870001~

HYUNDAI
HEAVY INDUSTRIES CO.,LTD.

INTRODUCTION

To insure a long life for the machine and the engine and to prevent failure and problems, proper operation, maintenance and repairs are imperative.

This service manual includes an “outline,” “structure and operation,” “inspection and adjustment,” “disassembly and assembly,” “standard maintenance,” and “repair and replacement of parts” of the machine which are necessary to carry out the inspections and repairs in the repair shop.

We trust that this manual will help you to effectively carry out the necessary. Repairs should they arise, also provide a accurate description of the product, and the correct repair procedures.

CONTENTS

1. Precautions on Maintenance
2. Outline
3. Attachment
4. Engine
5. Main Pump
6. Hydraulic Oil Filter
7. Control Valve
8. Joystick
   (Pilot Valve)
9. Pilot Valve (1)
   (Travel)
10. Pilot valve (2)
    (Swing, PTO)
11. Pilot Valve (3)
    (Dozer)
12. Slew Motor
13. Travel Motor
14. Hydraulic Cylinder
15. Swivel Joint
16. Crawler
17. Spring Case and Grease Cylinder
18. Idler
19. Sprocket
20. Track Roller
21. Carrier Roller
22. Electrical Equipment
23. Troubleshooting

1 PRECAUTIONS ON MAINTENANCE

1. Correct operation

Correct operation means to follow the correct “procedure” and “method.”
Procedure focuses on speed and accuracy of each job.
In the method, are addressed what type of facility, tools, instruments, materials, oil should be used, how and which part should be checked, adjusted or disassembled, and what matters to attend to.

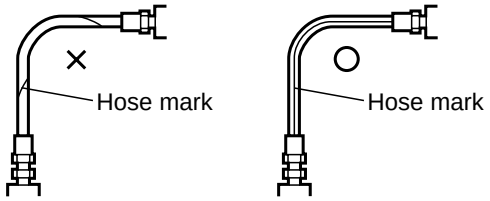
2. Precautions on operation

1. Safety check
   Check that stoppers and sleepers are correctly installed for the vehicle jack-up operation.

2. Preparation
   Prepare all of the tools and inspect and adjust the instruments.

3. For efficiency
   1) Understand the state before disassembly.
      What is the problem? Is disassembly absolutely necessary?
   2) Before disassembly
      Determine whether match marks are necessary. For the electrical system, disconnect the cable from the battery terminal.
   3) Precautions for disassembly
      In stead of checking all of the disassembled parts at once, check each part individually as it is disassembled. When removing the hydraulic unit or the hoses, mount a dust cap on the connection.
   4) Repair of disassembled parts
      Keep the disassembled parts in order. Clearly distinguish the parts to be replaced with new parts from those to be reused. Packings, seals, rings, split pins must be replaced.

   NOTE:
      Electrical equipment, rubbers and V belts (which are easily affected by water and oil) must be handled carefully in order to prevent soiling them.
   5) Clean disassembled parts
      Thoroughly clean the disassembled parts.
   6) Assembly
      Perform the assembly correctly (tightening torque, application of Three Bond, screw lock, grease, use of seal tape, etc.). Also install the hose correctly.

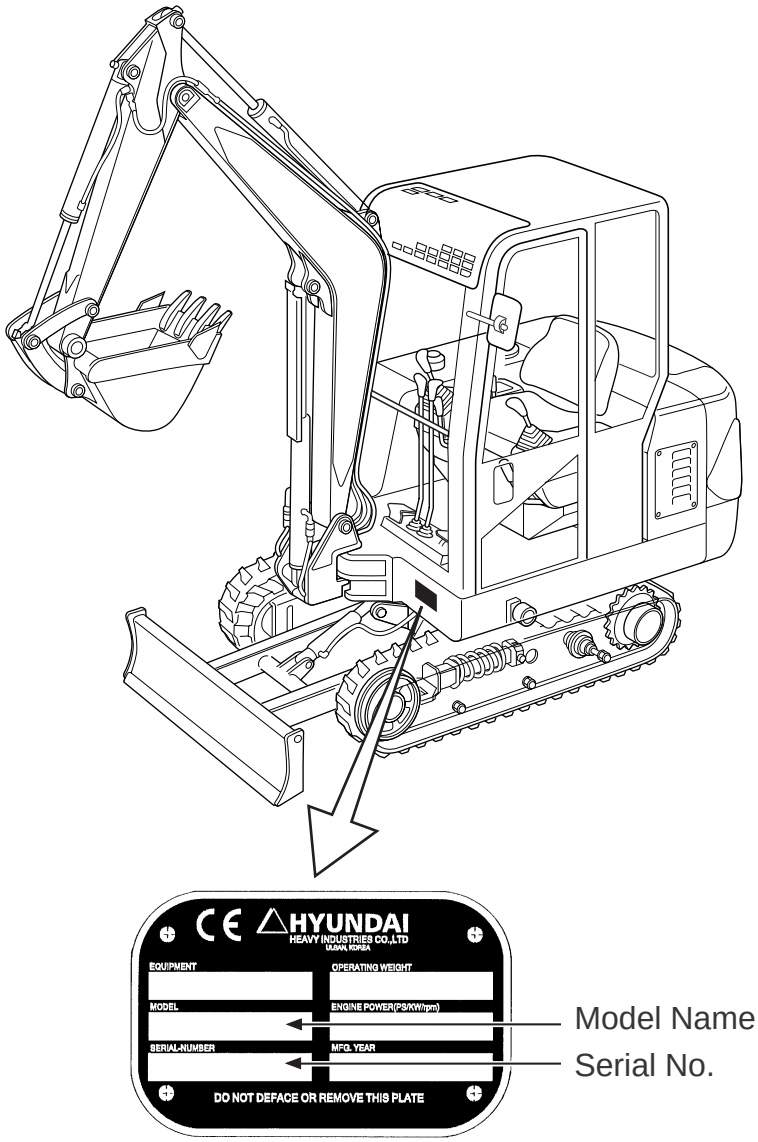


2 OUTLINE

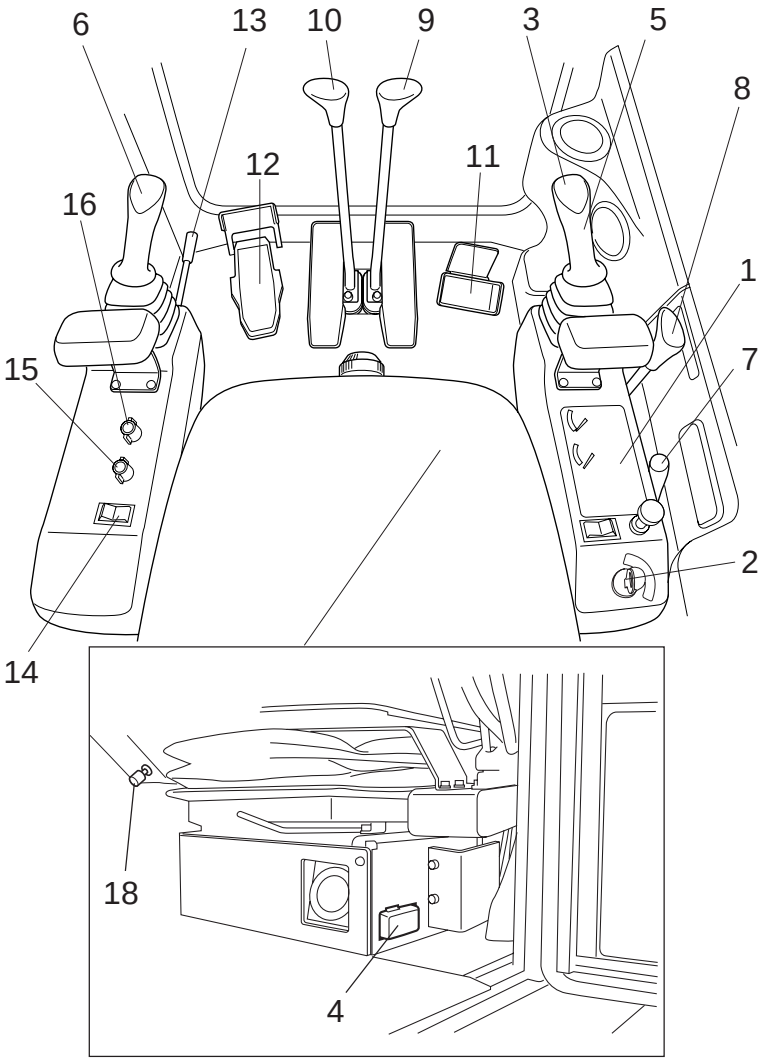
CONTENTS

2-1 Location of serial No.
2-2 Name of each part
2-3 Dimensions and specification
2-3-1 H26C PTO flow
2-4 Weight list
2-5 Oil and grease supply points
2-6 List of supply oil and grease
2-7 When to repair
2-8 Hydraulic circuit diagram

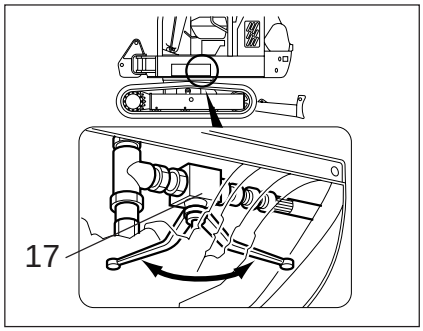
2-1 Location of Serial Number

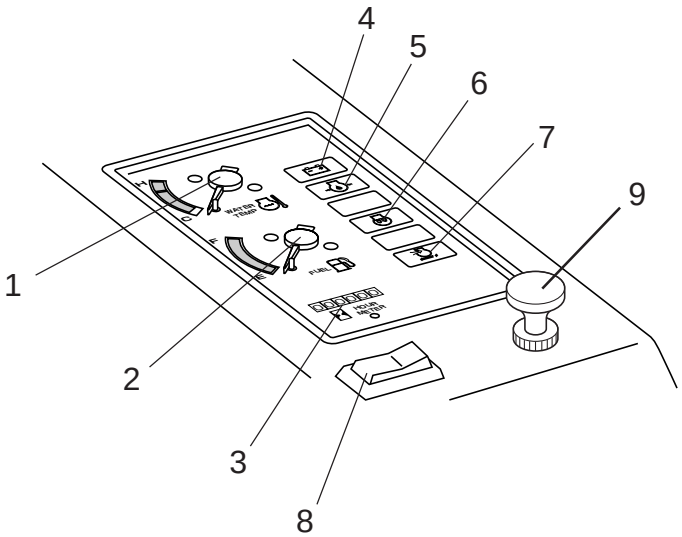


2-2 Name of each part



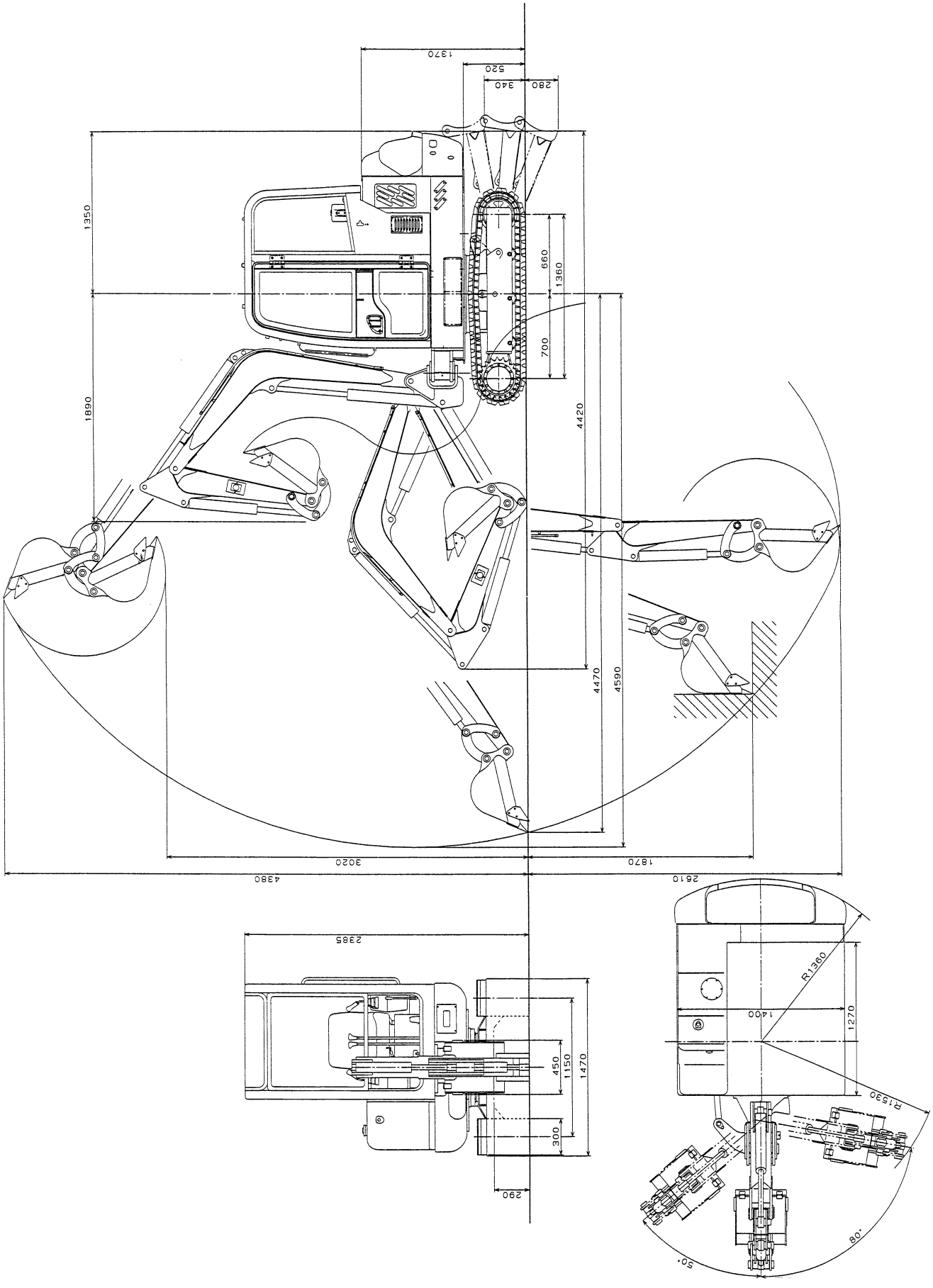
1. Meter unit
2. Starter switch
3. Horn switch
4. Fuse box
5. Right operation lever
6. Left operation lever
7. Accelerator lever
8. Dozer lever
9. Right travel lever
10. Left travel lever
11. Swing pedal
12. P.T.O. pedal
13. Operation lock lever
14. Over drive switch
15. Hearter switch (for cabin)
16. Wiper switch (for cabin)
17. Manual boom lower lever
18. Cigarette lighter





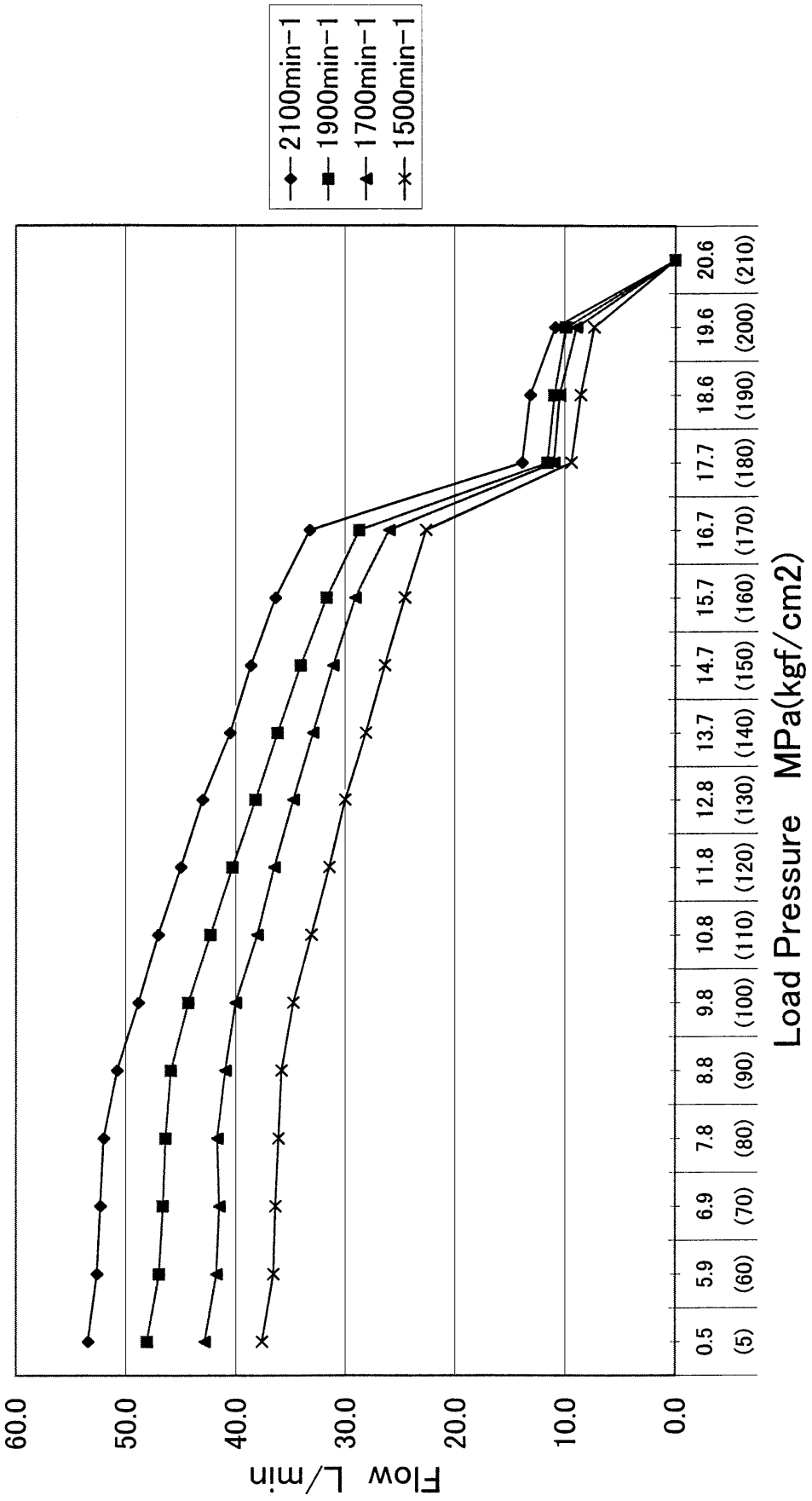
1. Water temperature meter
2. Fuel gauge
3. Hour meter
4. Charge lamp
5. Engine oil pressure lamp
6. Glow lamp
7. Air filter lamp
8. Head light switch
9. Heater change lever
   (cold↔warm)

2-3 Dimensions and Specifications



Description			Unit	Robex28-7	
Machine weight	Canopy	Rubber shoe	Kg	2750	
		Steel shoe		2760	
	Cabin	Rubber shoe		2660	
		Steel shoe		2670	
Standard bucket	Capacity		m^3	0.07	
	Width		mm	450	
Engine	Maker, model			MITSUBISHI S3L2	
	Rated power		ps(kW)/min^{-1}	24.1(17.7)/2100	
	Displacement		cc	1318	
Working range	Arm length		mm	1165(std.)	1465(long)
	Max.digging depth			2610	2900
	Max.vertical digging depth			1870	2140
	Max.digging height			4380	4575
	Max.dumping height			3020	3220
	Max.digging reach			4590	4830
	Min.swing radius	Front		1890	1950
		Swing		1530	1580
	Rear end radius			1350	
	Boom swing angle		deg	Left80/Right50	
Dimension	Overall length		mm	4420	
	Overall width			1470	
	Overall height			2385	
	Dozer(width × height)			1470×300	
Performance	Travel speed		km/hr	2.8/4.0	
	Swing speed		min^{-1}	10.3	
	Gradeability		deg(%)	30(58)	
	Max.digging force	Bucket	kN(kgf)	25.6(2610)	
		Arm		15.6(1595)	
	Max. drawbar pull			24.1(2460)	
Under-carriage	Ground pressure	Canopy&rubber shoe	kpa(kgf/cm^2)	30.4(0.31)	
		Cabin&rubber shoe		29.5(0.30)	
	Tumbler distance × track gauge		mm	1360×1150	
	Track shoe width			300	
	Type of travelling motor			Piston shoe-in type	
	Crawler tension system			Grease cylinder	
Hydraulic	Type of hydraulic pump			Piston×2, Gear×1	
	Pump oil flow		ℓ/min	2×33.6+22.1	
	Auxiliary circuit oil flow			55.7	
	Relief valve setting pressure		MPa(kgf/cm^2)	20.6/17.2(210/175)	
Capacity	Hydraulic oil tank		ℓ	50.5	
	Engine oil			4.5	
	Fuel tank			42	
	Cooling water			5.5	
Noise	Noise level(LwA/LpA)		dB	94/78	

2-3-1 Robex 28-7 PTO Flow

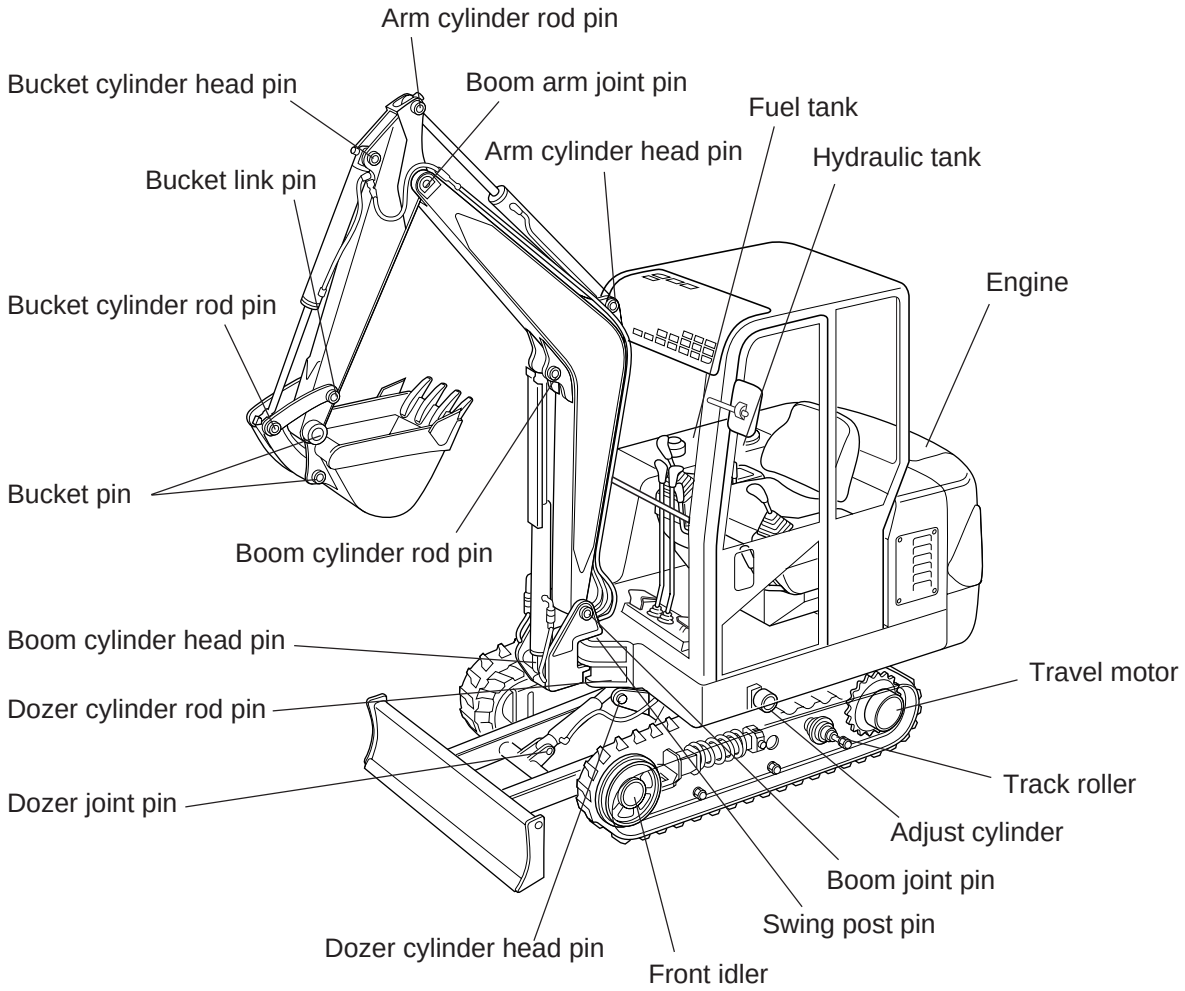


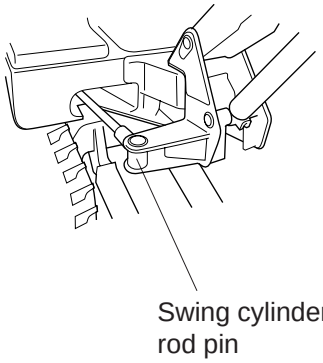
2-4 Weight list

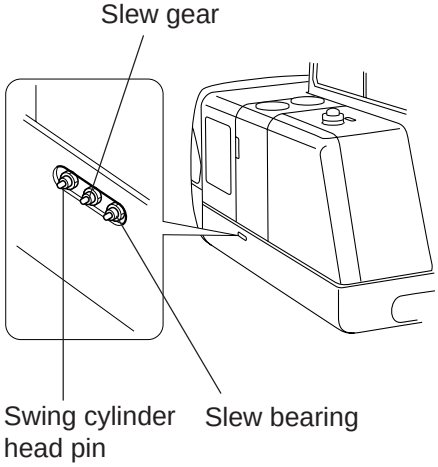
Unit: kgf

Part name	Robex 28-7	Part name	Robex 28-7
Boom	98	Swing cylinder	22
Arm	55	Dozer cylinder	18
Bucket	51	Turning bearing	42
Dump link	10	Track frame	280
Bucket link	2.8×2	Dozer	113
Boom joint pin	2.6	Steel crawler	156×2
Arm joint pin	1.6	Rubber crawler	138×2
Bucket pin	1.7×3	Idler	19×2
Swing post	59	Adjust cylinder	18×2
Swing post pin	6.5	Track roller	6.8×6
Swing frame	325	Carrier roller	2.5×2
Hydraulic oil tank	35	Sprocket	6.5×2
Fuel tank	18	Turning motor	22
Engine cover(A)	31	Drive motor	36×2
Engine cover(B)	13.5	Console box	9×2
Counter weight	150	Engine	135
Guard(R)(L)	35×2	Radiator	6
Guard(Center)	10.5	Battery	22
Tops roof	90	Battery cover	3
Operator cabin	165	Swivel joint	21
Boom cylinder	28	Control valve	27
Arm cylinder	28	Pump	23
Bucket cylinder	23	Seat plate	14

2-5 Oil and grease supply points







2-6 List of lubrication

Name	Quantity of oil/water	Type of oil according to ambient condition	
		-10°C~40°C	-20°C~0°C
Engine cooling water	5.5 ℓ	Soft water (antifreeze is mixed in water)	
Fuel tank (effective capacity)	42 ℓ	Diesel fuel with freezing point below -7°C	
Engine lubricating oil	4.5 ℓ	SAE 10W-30	
Travel motor (reduction gear)	600 cc	SAE 30-CD	
Hydraulic tank	50.5 ℓ	ISO VG 46	
Track roller (1 piece)	100 cc	SAE 30-CD	
Front idler (1 piece)	80 cc	SAE 30-CD	

Genuine oil

Be sure to use Castrol Hyspin 46.

Table of recommended Lubricants

No.	LUBRICANT	SHELL	MOBIL
1	Engine Oil	Myrina oil 15W-40	Delvac Super15W-40
2	Gear Oil	Spirax Heavy Duty 140	Mobilub HD 85W-140
3	Hydraulic Oil	ISO VG 46 (equivalent)	ISO VG46 (equivalent)
4	Cup Grease	Alvinia 2	Mobilux 2
5	Anti Freeze	Anti Freeze	Anti Freeze
6	Diesel Fuel	—	—

*The engine oil SAE-CD 15W=40 or equivalent at the time of shipment is used for the lubricating oil for slewing and travelling speed reducer.

Cooling water (antifreeze)

*To prevent the cooling system from freezing, add antifreeze to the cooling water. Replace the cooling water after 1 year from its delivery, because the effect will decrease.
*Use "Long-life coolant" for the antifreeze.
*Mixing ratio of antifreeze.

Temperature	-5°C	-10°C	-15°C	-20°C	-25°C	-30°C
antifreeze ratio	1.7	2.2	2.7	3.1	3.5	3.8

Engine inside capacity	Radiator capacity	Reserve tank capacity	Total
2.5 ℓ	2.4 ℓ	0.6 ℓ	5.5 ℓ

2-7 When to repair

It is difficult to judge when to perform periodic inspections, maintenance and repairs. Although the wearing rate of each component differs depending on the grade of daily inspection, the skill in machine operation, the working conditions, the quality of used lubricating oil, the frequency of oil replacement, the quality of land to be dug, the digging rate, the schedule for maintenance and repairs should be decided considering the state of engine, the indication of the hour meter, the degree of wear in each part, the state of hydraulic system, your experience and data.

2-7-1 Category of maintenance

Prestart-up inspection	Execute every day before beginning operation
Maintenance after the first 25 service hours	Execute every 25 hours by the hour meter
Maintenance after the first 50 service hours	Execute once a week (every 50 hours by the hour meter)
Maintenance after the first 100 service hours	Execute every 100 hours by the hour meter
Maintenance after the first 250 service hours	Execute every 250 hours by the hour meter
Maintenance after the first 300 service hours	Execute every 300 hours by the hour meter
Maintenance after the first 500 service hours	Execute every 500 hours by the hour meter
Maintenance after the first 1,000 service hours	Execute every 1,000 hours by the hour meter
Maintenance after the first 2,000 service hours	Execute every 2,000 hours by the hour meter

2-7-2 Maintenance procedure

	Inspection and maintenance item	Inspection and maintenance interval (hours)					
		7	50	100	250	500	1,000
1	Engine oil pan	Check oil level	Replace the engine oil (New machine only)		Replace the engine oil		Clean
	Engine oil filter		Replace the cartridge (New machine only)		Replace the cartridge		
2	Fuel filter			Check and clean		Replace the element	
3	Engine valve clearance		Inspect and adjust (New machine only)			Inspect and adjust	
4	Fan belt	Check and adjust					
5	Fuel tank	Check oil level	Drain water and sediment, clean strainer				
6	Radiator (sub-tank)	Check water level				Replace and clean	
	Radiator fin		Check and clean				
7	Air cleaner			Check and clean		Replace the element	
8	Hydraulic oil tank	Check oil level			Drain water and sediment		Replace oil
9	Hydraulic line filter			Replace the cartridge (New machine only)		Replace the cartridge	
10	Hydraulic suction filter			Clean the element (New machine only)		Replace the element	
11	Bucket teeth and others	Inspect					
12	Slew bearing		Inspect and grease				
13	Inspect crawler tension(grease cylinder) and grease the crawler	Check and adjust					
14	Battery liquid amount and specific gravity		Inspect, clean and supply distilled water				
15	Inspect each body part for loosening and damage	Check and tighten					
16	Each lever and instrument	Inspect					
17	Lubricating oil of slew/travelling reduction gear					Replace oil (after the first 500 service hours only for a new machine)	Replace oil
18	Electrical wiring	Inspect					
19	Water and oil leakage in each body part	Inspect					
20	Inspect and grease attachment	Inspect attachment					
21	PTO filter element				Replace the element		

2-7-3 Prestart inspections

(1)Prestart inspections

	Item	Content	Remarks
1	Engine oil pan	Check oil level	Before starting operation
2	Fuel tank	Check fuel level	Check that the fuel level is above the center of level gauge.
3	Radiator	Check water level	Check that the amount of water in sub-tank is within a specified level.
4	Each oil/grease supply point	Oil and grease	Refer to page 2-6
5	Inspect each body part for looseness and damage	Looseness, removal, water and oil leakage	Refer to tightening torque list.
6	Each lever and instrument	Operation check	Whether abnormal operation exists or not
7	Hydraulic oil tank	Check oil level	Add oil if its level falls below the specified level. (Be careful of the position of machine.)
8	Bucket teeth and others	Wear	Check whether the replacement of parts is necessary or not.
9	Electrical wiring	Looseness and tears	Loosened terminal, torn covering, etc.
10	Fan belt	Check and adjust	10mm(0.4”) to 12mm(0.5”) sag at the center

(2)Post opertaion inspections

	Item	Content	Remarks
1	Each body part	Clean, check for water and oil leaks. Looseness, failure, etc.	Treatment of the part where cleaning was not sufficient such as dirt sticking to the body or muddy water remaining on the body.
2	Fuel tank	Fuel supply	Add fuel
3	Cooling water	Drain	Only when the danger of freezing exists

Tightening torque list:

In the present inspection, always check for loosened bolts or nuts and correctly tighten them according to the following tightening torque list.

N-m Tightening torque of the bolt and nut (Body)

Material / Size	8.8 N·m	10.9 N·m	12.9 N·m
M6	12.5	16	20
M8	30	39	45
M10	62	72	80
M12	100	120	130
M14	160	195	220
M16	250	305	340

N-m Tightening torque of the hydraulic pipings

PT screw

Torque / Size	N·m
1/4	36
3/8	55
1/2	86
3/4	130
1	195
1 1/4	300
1 1/2	400

PF screw

Torque / Size	N·m
1/4	27-30
3/8	47-52
1/2	57-63
3/4	108-120
1	126-140

2-7-4 Maintenance every 50 service hours

	Item	Content	Remarks
1	Engine oil pan	Replace engine oil and filter	Only for a new machine. After this, every 250 service hours
3	Engine valve clearance	Inspect and adjust	Only for a new machine. After this, every 500 service hours
5	Fuel tank	Drain sediment and water	Remove the drain plug on the lower part of the tank
		Clean the strainer	Wash strainer with diesel fuel
	Radiator fin	Clean the fins	Dust sticking to the fin affects the cooling effect and causes overheating
6	Slew bearing	Inspect and grease	Always grease the machine after it is used in water
12	Battery	Liquid quantity	Whether the liquid level is proper or not. If short, add distilled water
14	Battery	Specific gravity	1.26 when fully charged; 1.20 when discharged (Recharge the battery when 1.20.)
		Clean	Clean each part, brush and connect terminal and apply grease
20	Each oil/grease supply point	Oil and grease	Refer to page 2-7

2-7-5 Maintenance every 100 service hours

	Item	Content	Remarks
2	Fuel filter	Clean the element	After cleaning, open the cock to vent air
7	Air cleaner	Clean the dust cover, clean or replace the element	Check also for a loosened band
9	Hydraulic line filter	Replace the cartridge	Only for a new machine. After this, every 500 service hours
10	Hydraulic suction filter	Clean the element	Only for a new machine. After this, every 500 service hours

2-7-6 Maintenance every 250 service hours

	Item	Content	Remarks
1	Engine oil	Replace the engine oil	Remove the drain plug on the lower part of the tank. (After 50 service hours for a new machine)
	Engine oil filter	Replace the cartridge	After 50 service hours for a new machine
8	Hydraulic oil tank	Drain water and sediment	After air is vent, loosen the drain plug
17	Lubricating oil of slew and travelling reduction gears	Replace lubricating oil	Replace oil after the first 200 service hours. Every 1,000 service hours after this (Refer to Table of Oil/Grease Supply Points)

2-7-7 Maintenance every 500 service hours

	Item	Content	Remarks
2	Fuel filter	Replace the element	Clean the inside of bowl
3	Engine valve clearance	Check valve clearance	Clearance between the valve and the rocker
6	Radiator	Replace cooling water and clean the radiator	Remove the drain plug, clean the radiator and add water to the sub-tank up to the specified level.
7	Air cleaner	Replace the element	
9	Hydraulic line filter	Replace the cartridge	After 100 service hours for a new machine
10	Hydraulic suction filter	Clean the element	

2-7-8 Maintenance every 1,000 service hours

	Item	Content	Remarks
1	Engine oil pan	Clean engine oil pan	
8	Hydraulic oil tank	Replace the hydraulic oil and clean the oil tank	Clean the inside of the tank
12	Lubricating oil of slew and travelling reduction gears	Replace the lubricating oil	Refer to Table of Oil/Grease Supply Points. (For new machine, every 200 service hours)

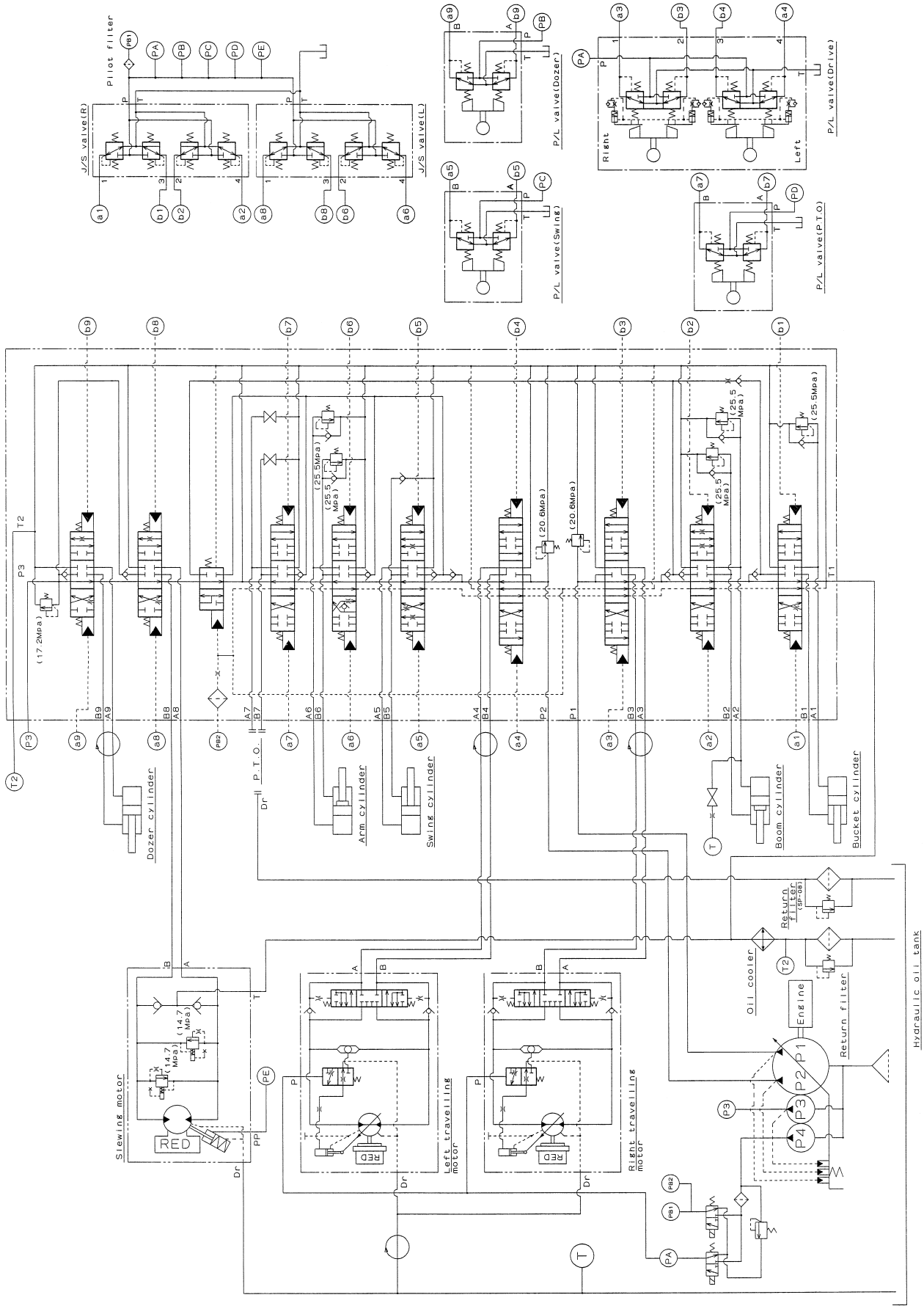
2-7-9 Maintenance every 2,000 service hours

	Item	Content	Remarks
15	Track roller	Replace	

Table of Oil/Grease Supply Points

No.	Oil/Grease Supply Point	Specified oil (genuine part)	Quantity	Time
1	Travel motor	API Classification CD Class SAE30	600 cc	Every 1,000 service hours (At first, replace after the first 500 service hours)
2	Track roller		100 cc	Every 2,000 hours
3	Front idler		80 cc	Every 2,000 hours

2-8 Hydraulic circuit diagram



Item	Robex 28-7
Boom cylinder	ø75×ø40×564 st
Arm cylinder	ø75×ø40×510 st
Bucket cylinder	ø70×ø45×417 st
Swing cylinder	ø65×ø40×627 st
Dozer cylinder	ø75×ø40×125 st
Slew motor	PCR-1B-05A-P-8446Z1
Travel motor	PHV-250-37-1-8761A

	Item		Robex 28-7
Pump capacity	P1		16.0 cc/rev
	P2		16.0 cc/rev
	P3		10.5 cc/rev
Pressure	Main relief	P1	20.6 MPa
		P2	20.6 MPa
		P3	17.2 MPa
	Port relief		23.5 MPa
	Unload (pump)		2.9 MPa
	Slew		13.2 MPa
Pump flow rate	Q1		33.6 ℓ/min
	Q2		33.6 ℓ/min
	Q3		22.1 ℓ/min
Engine	Type		S3L2
	Constant output		17.7 kW (24.1 ps)
	Speed		2,100 min^{-1}
	Torque		85 N·m/1,800 min^{-1}

3 ATTACHMENT

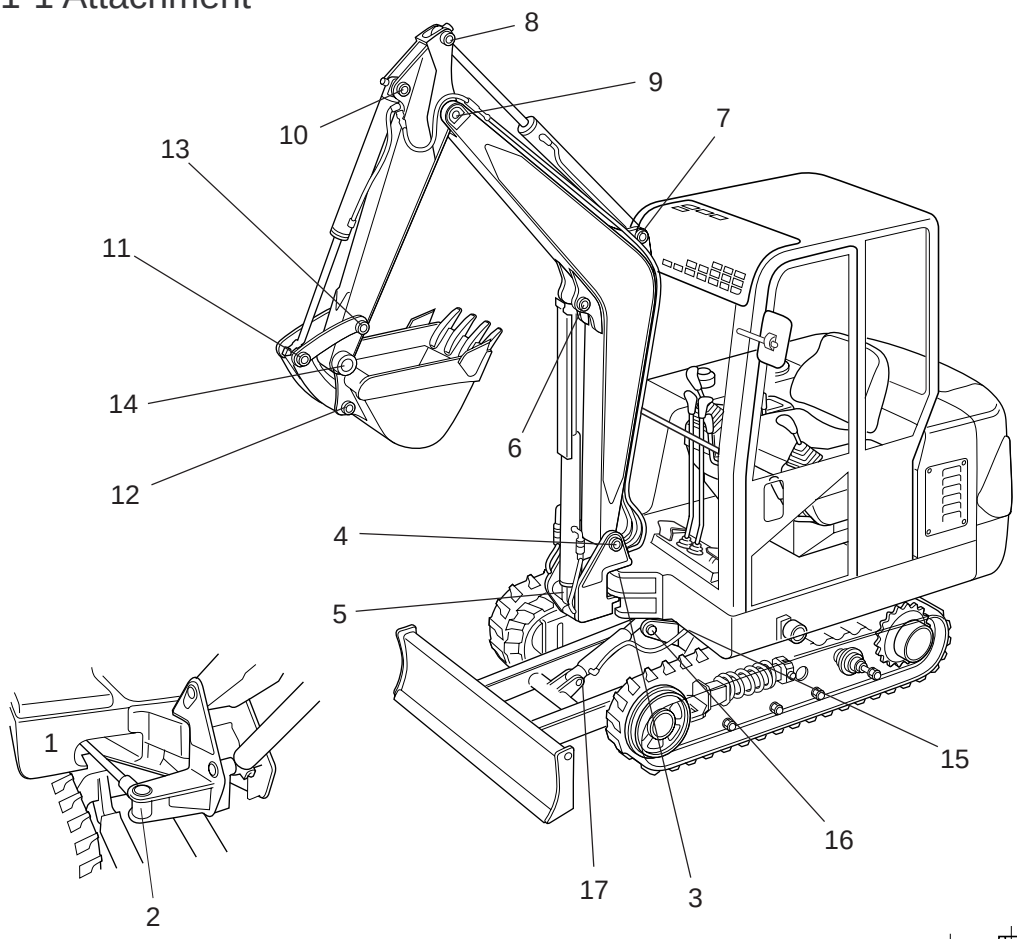
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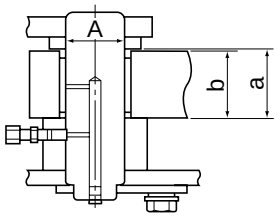
3-1 Standard of maintenance
- 3-1-1 Attachment

3-2 Inspection and adjustment
- 3-2-1 Measuring the fall of the attachment of its own weight
- 3-2-2 Measuring the speed of the attachment cylinder

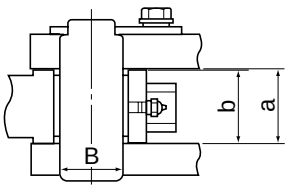
3-1 Standard of maintenance

3-1-1 Attachment

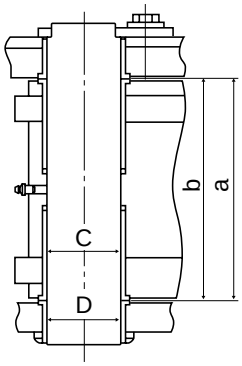




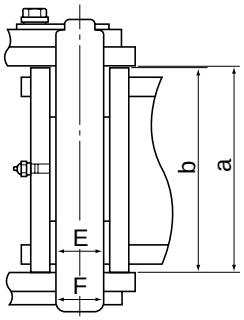
1. Swing cylinder head



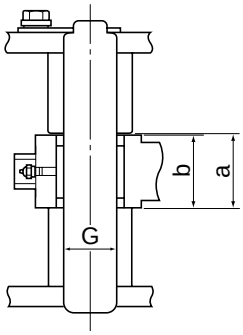
2. Swing cylinder rod



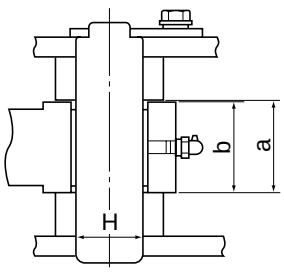
3. Swing post bracket and swing post



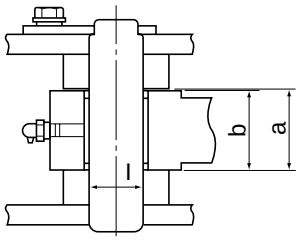
4. Boom joint



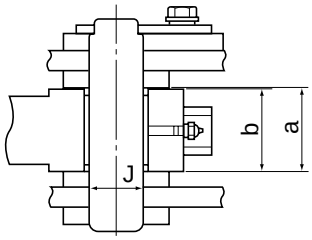
5. Boom cylinder head



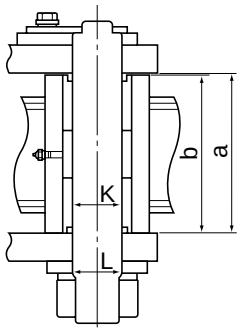
6. Boom cylinder rod



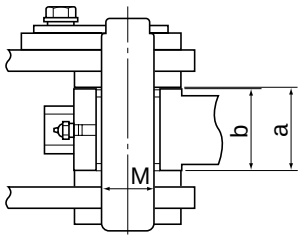
7. Arm cylinder head



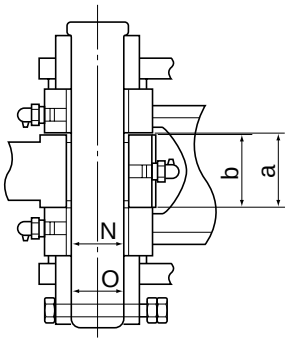
8. Arm cylinder rod



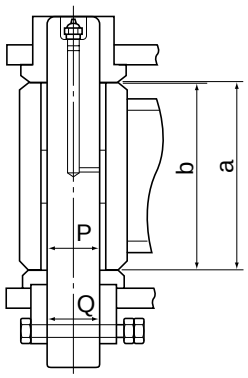
9. Boom/arm joint



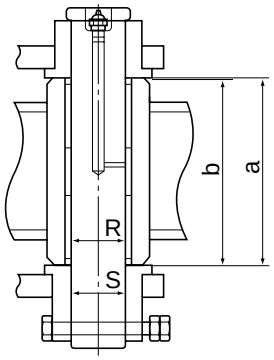
10. Bucket cylinder head



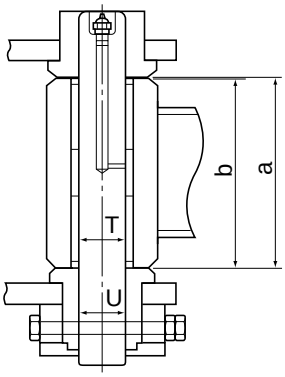
11. Bucket cylinder rod



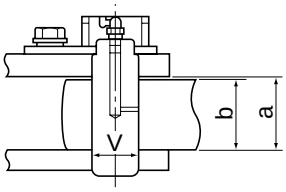
12. Bucket/dump link joint



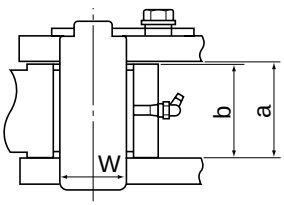
13. Arm/bucket link joint



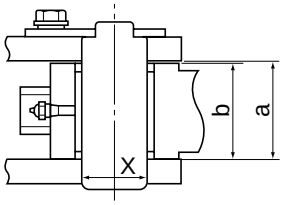
14. Arm/bucket joint



15. Dozer joint



16. Dozer cylinder rod



17. Dozer cylinder head

Unit: mm(in)

No.	Item	Basic Dimension	Allowable Clearance
A	Swing cylinder head pin and head bracket	ø34.7(1.37")	1.0(0.04")
B	Swing cylinder head pin and the boss of head bracket	ø35(1.4")	1.0(0.04")
C	Swing cylinder rod pin and swing post	ø35(1.4")	1.0(0.04")
D	Swing post pin and bush	ø60(2.4")	1.0(0.04")
E	Swing post pin and swing post bracket	ø60(2.4")	1.0(0.04")
F	Boom joint pin and bush	ø40(1.6")	1.0(0.04")
G	Boom joint pin and swing post	ø40(1.6")	1.0(0.04")
H	Boom cylinder head pin and swing post	ø40(1.6")	1.0(0.04")
I	Boom cylinder rod pin and boom	ø40(1.6")	1.0(0.04")
J	Arm cylinder head pin and boom	ø35(1.4")	1.0(0.04")
K	Arm cylinder rod pin and arm	ø35(1.4")	1.0(0.04")
L	Boom/ arm joint pin and bush	ø35(1.4")	1.0(0.04")
M	Boom/ arm joint pin and boom	ø35(1.4")	1.0(0.04")
N	Bucket cylinder head pin and arm	ø35(1.4")	1.0(0.04")
O	Bucket cylinder rod pin and dump link	ø35(1.4")	1.0(0.04")
P	Bucket cylinder rod pin and bucket link	ø35(1.4")	1.0(0.04")
Q	Bucket pin and bush	ø35(1.4")	1.0(0.04")
R	Bucket pin and bucket	ø35(1.4")	1.0(0.04")
S	Bucket link pin and bush	ø35(1.4")	1.0(0.04")
T	Bucket link pin and bucket link	ø35(1.4")	1.0(0.04")
U	Dozer joint pin and frame	ø35(1.4")	1.0(0.04")
V	Dozer cylinder head pin and dozer	ø35(1.4")	1.0(0.04")
W	Dozer cylinder rod pin and frame	ø35(1.4")	1.0(0.04")

Unit: mm(in)

No.	Item	Criterion			Spacer	
		a	b	Standard clearance	Part Number	Dimension
1	Clearance between swing cylinder head and swing post	53(2.1")	50(2.0")	2.0~3.5(0.08"~0.14")	NBU3-00020 NBU3-00021	ø36×t0.5 ø36×t1.0
2	Clearance between swing cylinder rod and head bracket	51(2.0")	50(2.0")	0.5~2.0(0.02"~0.08")	〃	〃
3	Clearance between swing post and frame	215(8.46")	213(8.39")	2.0~3.3(0.08"~0.13")	〃	〃
4	Clearance between boom and swing post	173.5(6.8")	172.5(6.8")	1.0~3.5(0.04"~0.14")	MBU3-00022 MBU3-00023	ø41×t0.5 ø41×t1.0
5	Clearance between boom cylinder head and swing post	51(2.0")	50(2.0")	1.0~2.5(0.04"~0.10")	MBU3-00020 MBU3-00021	ø36×t0.5 ø36×t1.0
6	Clearance between boom cylinder rod and boom	51(2.0")	50(2.0")	1.0~2.5(0.04"~0.10")	〃	〃
7	Clearance between arm cylinder head and boom	51(2.0")	50(2.0")	1.0~2.5(0.04"~0.10")	〃	〃
8	Clearance between arm cylinder rod and arm	51(2.0")	50(2.0")	1.0~2.5(0.04"~0.10")	〃	〃
9	Clearance between boom and arm	130.5(5.14")	129(5.07")	1.5~3.0(0.06"~0.12")	〃	〃
10	Clearance between bucket cylinder head and arm	51(2.0")	50(2.0")	1.0~2.5(0.04"~0.10")	〃	〃
11	Clearance between bucket cylinder rod and dump link	51(2.0")	50(2.0")	1.0~2.5(0.04"~0.10")	〃	〃
12	Clearance between dump link and bracket	135(5.3")	134.5(5.3")	0.5~1.0(0.02"~0.04")	〃	〃
13	Clearance between arm and bucket link	135(5.3")	134.5(5.3")	0.5~1.0(0.02"~0.04")	〃	〃
14	Clearance between arm and bucket	135.5(5.3")	134.5(5.3")	1.0~1.5(0.04"~0.06")	〃	〃
15	Clearance between dozer and frame	32(2.1")	30(2.0")	1.5~4.0(0.06"~0.16")	〃	〃
16	Clearance between dozer cylinder rod and frame	51(2.0")	50(2.0")	1.0~2.0(0.04"~0.08")	〃	〃
17	Clearance between dozer cylinder head and dozer	51(2.0")	50(2.0")	1.0~2.0(0.04"~0.08 ")	〃	〃

3-2 Inspection and adjustment

3-2-1 Measuring the natural fall of the attachment

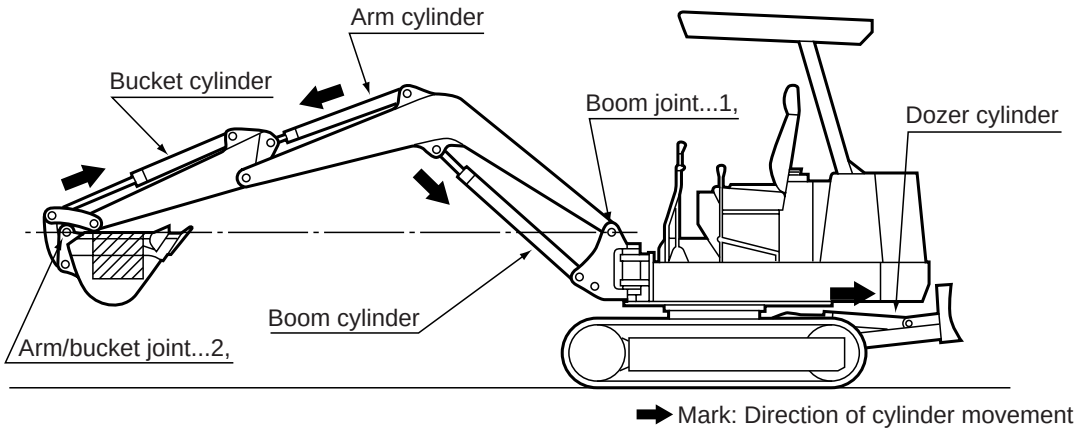
1. Measuring the location of the attachment
   Set the temperature of the hydraulic oil to 50±5°C. Adjust the height of arm/bucket joint so that it equals that of the boom joint. Then, retract the dozer cylinder to the minimum length and stop the engine.
2. Measurement
   Draw a reference line on the cylinder head with a Magic Marker and measure the length from the line to the cylinder tube. Measure the length again 3 minutes later. Then record the difference in the length

Unit: mm (or less)

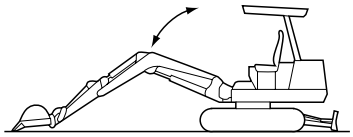
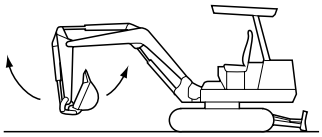
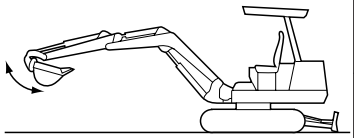
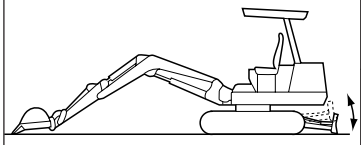
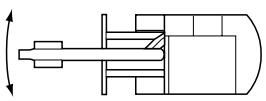
Cylinder name	Standard value	Allowance
Boom cylinder	13	26
Arm cylinder	13	26
Bucket cylinder	8	16
Dozer cylinder	7	14

Make 1 and 2 the same height.

W: Weight	About: 110 kg



3-2-2 Measuring the speed of attachment cylinder (at full engine speed and oil temperature 50±5°C)

Condition	Machine position		Unit	New standard value	Allowable limit
Boom Make bucket teeth touch the ground Extend cylinder to the Maximum length		Up	sec	2.8±0.5	3.6
		Down		2.7±0.5	3.5
Arm Retract cylinder to the minimum length Extend cylinder to the maximum length		Dig		3.1±0.6	3.8
		Dump		3.0±0.5	3.9
Bucket Retract cylinder to the minimum length Extend cylinder to the maximum length		Dig		3.0±0.5	3.9
		Dump		2.0±0.4	2.8
Dozer Make dozer contact the ground Lift dozer to the maximum height		Up		1.2±0.3	1.7
		Down		0.9±0.3	1.2
Swing Retract cylinder to the minimum length Extend cylinder to the maximum ground		Right swing		6.7±0.5	8.7
		Left swing		6.5±0.6	8.5

4 ENGINE

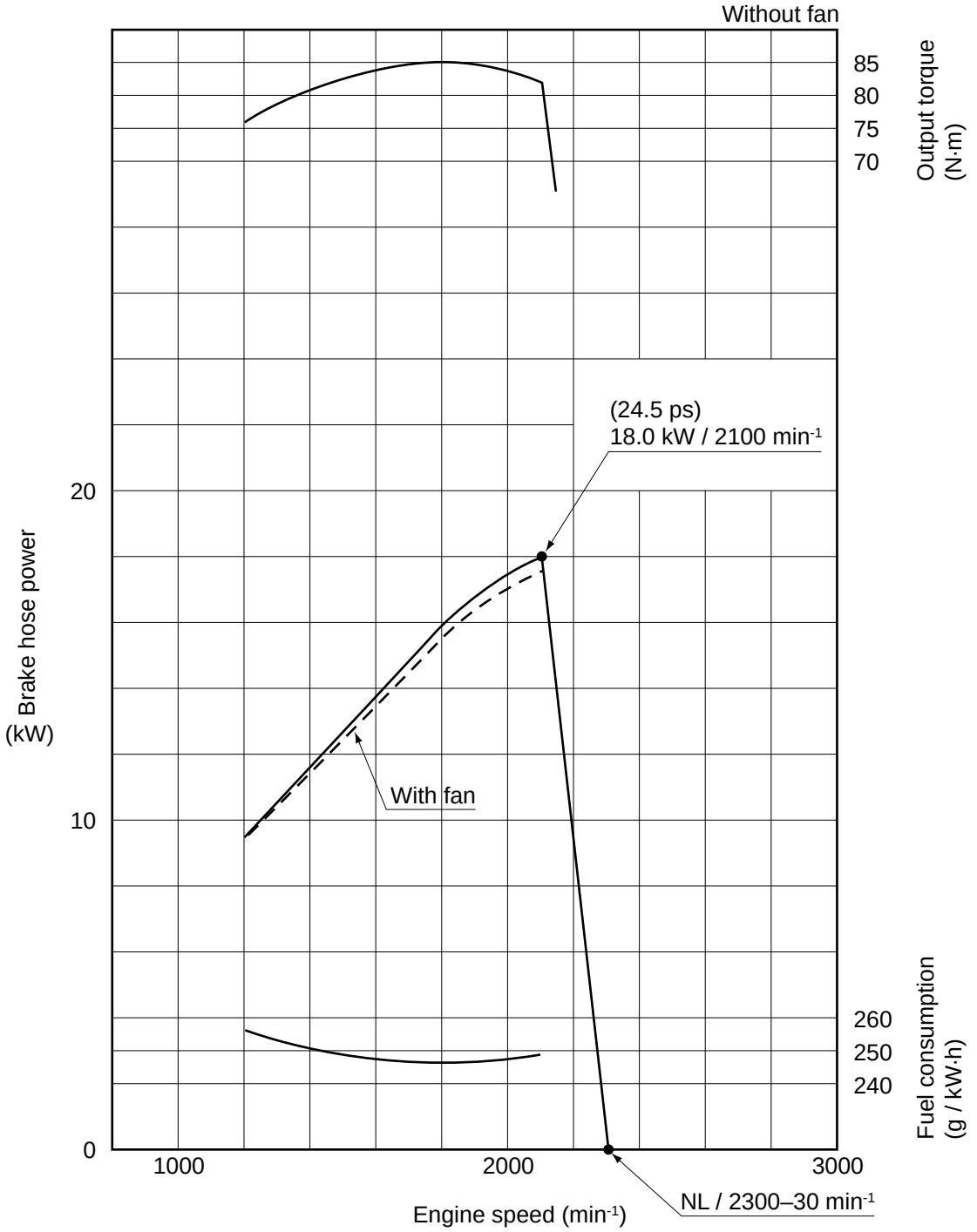
CONTENTS

4-1 Specification
4-2 Performance curve
4-3 Location of serial number
4-3-1 Engine
4-3-2 Standard engine speed
4-4 Inspection and maintenance procedures for engine parts

4-1 Specification

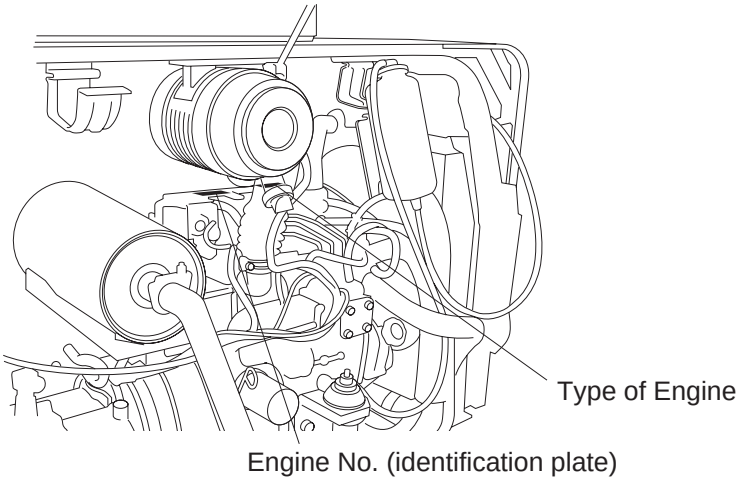
Engine		S3L2
Type		In-line 3 cylinder 4cycle overhead valve type
Number of cylinders–bore × stroke		3–78 mm × 92 mm
Displacement		1,318 cc
Ignition order		1–3–2
Dimensions	Overall length	556 mm
	Overall width	440 mm
	Overall height	615 mm
Performance	Rated output	17.7 kW(24.1) / 2,100 min^{-1}
	Maximum torque	85 N·m / 1,800 min^{-1}
	Maximum idling speed	2,300 ± 30 min^{-1}
	Minimum idling speed	1,200 ± 30 min^{-1}
	Fuel consumption	247 g / kW.h
Dry weight		135 kg
Fuel oil		Diesel fuel
Fuel pump		Bosh type
Governor		Centrifugal type
Generator		12V × 50A
Starter		12V × 1.7 kW
Battery		12V × 50 AH

4-2 Performance curve



4-3 Location of serial number

4-3-1 Engine



4-3-2 Standard engine speed (at new machine delivery)

Conditions	Idling speed
Maximum idling speed	2,300 ± 30 min^{-1}
Speed when 1P relief is used	2,230 ± 70 min^{-1}
Speed when 2P relief is used	2,200 ± 70 min^{-1}

4-4 Inspection and maintenance procedure for engine parts

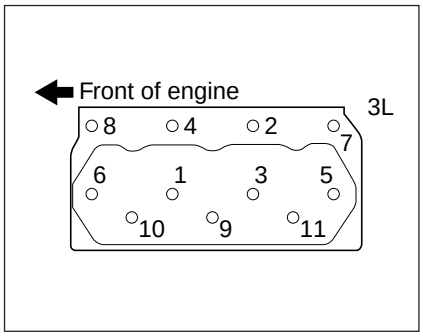
Inspecting and Adjusting Valve Clearance

NOTE

Make an adjustment to the valve clearance when the engine is cold.

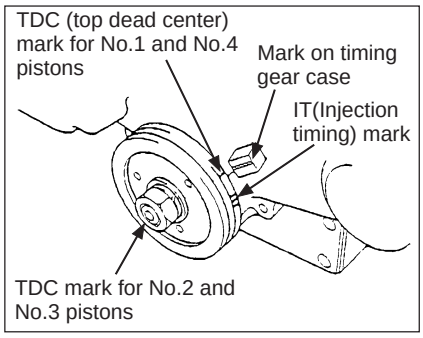
(1) Slightly loosen the cylinder head bolts and retighten them to the specified torque in number sequence.

Tightening torque	9 ± 0.5 kgf·m (88 ± 5 N·m)



Cylinder head bolt tightening sequence

(2) Find top dead center compression position for No.1 piston by using the procedure that follows:
   (a) Turn the crankshaft until TDC mark on the crankshaft pulley is aligned with the mark on the timing gear case.
   (b) With No.1 piston at top dead center on the compression stroke, the rocker arms will not be moved when the crankshaft is turned approximately 20° in both directions.
   (c) With No.1 piston at top dead center on the compression stroke, the rocker arms will not be moved when the crankshaft is turned approximately 20° in both directions.



Timing mark

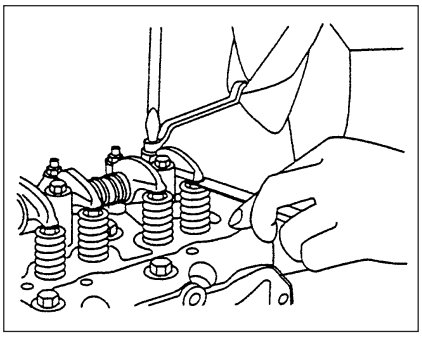
(3) Loosen the lock nut for the adjusting screw. With a feeler gauge inserted between the rocker arm and valve cap, adjust the valve clearance by turning the adjusting screw.

Unit: mm(in.)

Item	Standard
Valve clearance (both inlet and exhaust valves)	0.25(0.0098)

(4) Hold the adjusting screw and tighten the lock nut.
(5) After the valve clearance of the valves for No.1 cylinder has been adjusted, turn the crankshaft 180° in the direction of engine rotation and adjust the valve clearance on the valves for the remainder of the cylinders in firing order (injection sequence).

Firing order (injection sequence)		Crankshaft rotation angle
S3L	1–3–2	240°


Adjusting valve clearance

⚠ CAUTION

After the valve clearance on the valves for all cylinders has been adjusted, turn the vrankshaft two or three times and make sure the valve clearance is correct.

Inspecting and Adjusting Injection Nozzles

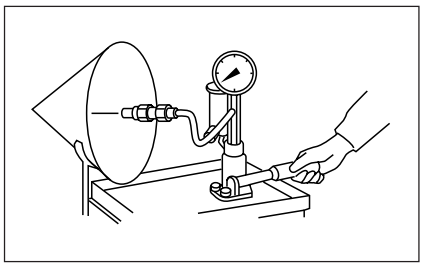
1.Inspection

(1) Injection pressure (valve opening pressure test)

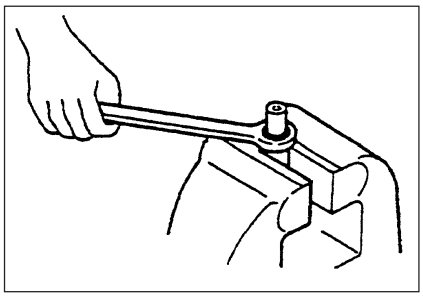
(a) Install the injection nozzle on the tester. Slowly operate the tester handle to bleed (remove) air from the tester.

(b) Operate the tester handle at a speed of one stroke per second to make a slow increase in pressure until the valve in the injection nozzle starts to open. Read the maximum gauge pressure at the instant fluid flows from the tip.

(c) If the injection pressure is incorrect, disassemble the nozzle and change the thickness of the washer.



Fuel injection nozzle ready for test



Removing tip from injection nozzle

Injection pressure (valve opening pressure) Standard	140^{+5}_{0} kgf/cm^2 (1991^{+71}_{0} psi) [13729^{+490}_{0} kPa]

NOTE

An increase or decrease of washer thickness by 0.1 mm(0.004 in.) will vary the injection pressure by 10kgf/cm^2 (142 psi)[981 kPa]. 10 kinds of washer are available in thickness from 1.25 mm(0.049 2 in.) to 1.70 mm(0.066 9 in.) in increments of 0.05 mm (0.002 0 in.)

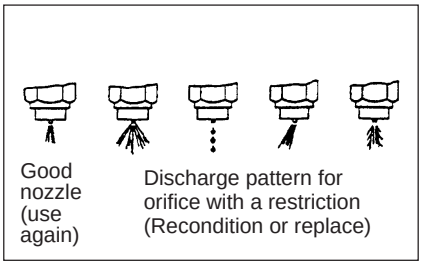
⚠ WARNING

When the injection nozzles are tested, be sure to wear eye protection. Fuel comes from the orifices in the nozzle tip with high pressure. The fuel can pierce (go through) the skin and cause serious injury to the operator. Keep the tip of the nozzle pointed away from the operator and into the fuel collector.

(2) Orifice restriction test

(a) Look at the orifice discharge pattern (shape of discharge) when fluid begins to flow through the injection nozzle. The discharge must be straight. Any change is an indication of a bad nozzle.

(b) Operate the tester handle at a speed of one stroke per second to make sure the discharge is straight.



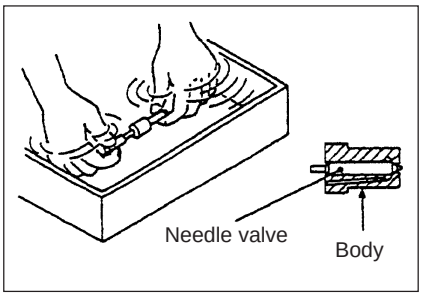
Orifice restriction test

(3) Nozzle tip washing and replacement

(a) loosen the retaining nut and remove the tip from the injection nozzle. Wash the needle valve and body in clean diesel fuel. After washing, put the needle valve in the body in clean diesel fuel.

⚠ CAUTION

Don not hit the tip when removing it from the injection nozzle.



Washing nozzle tip

NOTE

Keep the needle valves with their respective bodies. Do not use needle valves or bodies with other bodies or needle valves.

(b) After cleaning the tip, install it in the nozzle and tighten the retaining nut to the specified torque.

Tightening torque	3.75 ± 0.25 kgf·m (36.8 ± 2.5 N·m)

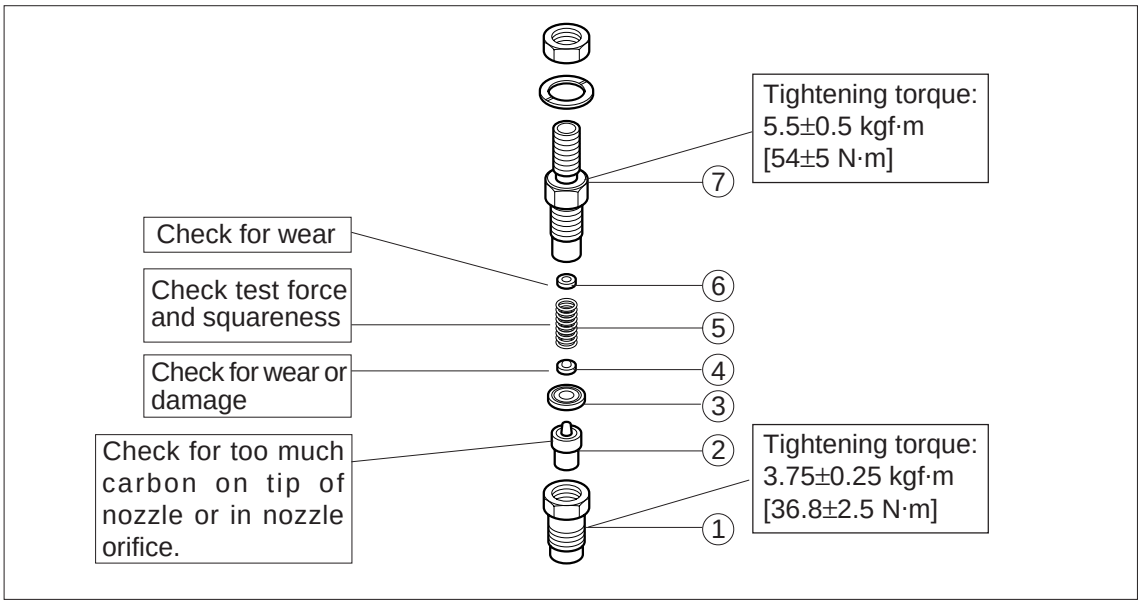
(c) If the injection nozzle is still bad after the tip has been washed, replace the tip.

NOTE

a) Do not touch the sliding surface of the needle valve.

b) When installing the new nozzle tip, remove synthetic resin film from the tip and slide the needle valve in the body in clean diesel fuel to wash off inhibitor completely.

Disassembly



Disassembly sequence and inspection points

① Retaining nut
② Nozzle tip asse
③ Piece
④ Pin
⑤ Spring
⑥ Washer
⑦ Body

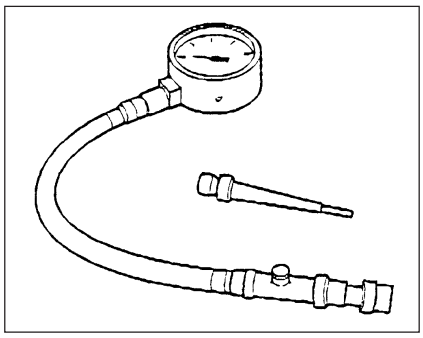
Measuring Compression Pressure

1. Inspection

Check to make sure–

(1) The crankcase oil level is correct. and the air cleaner, starter and battery are all in normal condition.

(2) The enigne is at the normal operating temperature.



Compression gauge and adapter

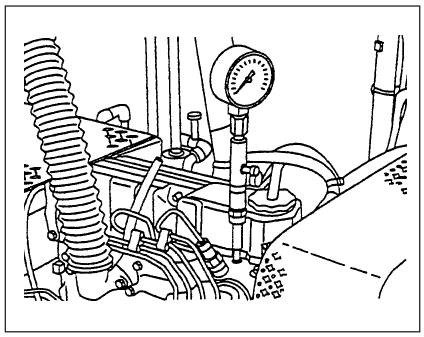
2. Measurement

(1) Move the control lever to a position for shutting off fuel supply.

(2) Remove all glow plugs from the engine. Install the compression gauge and adapter(ST332270) combination to a cylinder on which the compression pressure is to be measured.

(3) Turn the engine with the starter and read the gauge pressure at the instant the gauge pointer comes to stop.

(4) If the gauge reading is below the limit, overhaul the engine.



Measuring compression pressure

⚠ CAUTION

(a) Be sure to measure the compression pressure on all cylinders.

(b) The compression pressure varies with change of engine rpm. This makes it necessary to check engine rpm at the time of measuring the compression pressure.

Item	Standard		Limit
Engine speed, rpm	290		—
Compression pressure kgf/cm²(psi)[kPa]	SL	30 (427) [2942]	30 (427) [2942]
	SL2	32 (455) [3138]	32 (455) [3138]
Maximum permissible difference between average compression pressure of all cylinders in the engine. kgf/cm²(psi)[kPa]	3 (42.7) [294]		—

⚠ CAUTION

(a) It is important to measure the compression pressure at regular intervals to obtain the data on the gradual change of the compression pressure.

(b) The compression pressure would be slightly higher than the standard in a new or overhauled engine owing to breaking-in of the piston rings, valve seats, etc. It drops as the engine components wear down.

Bolt or nut	Thread, mm				Torque, kgf·m(lb·ft)[N·m]
	Diameter	Pitch	Width across flats	Clamp length	
Cylinder head bolt	M10	1.25	14	87	9±0.5(65±4)[88±5]
Rocker cover bolt	M8	1.25	12	40	1.15±0.15(8.3±1.1)[11.3±1.5]
Rocker shaft bracket bolt	M8	1.25	12	58	1.5±0.15(8.3±1.1)[11.3±1.5]
Thermoswitch	M16	1.5	17	31.5	2.3±0.4(16.6±3)[22.6±4]
Crankshaft pulley nut	M18	1.5	27	—	17.5±2.5(127±18)[172±25]
Main bearing cap bolt	M10	1.25	17	81	5.25±0.25(38±2)[51.5±2.5]
Connecting rod cap nut	M9	1.0	14	—	3.55±0.25(25.7±2)[34.8±2.5]
Rear plate bolt (for tractor engine)	M12	1.25	17	28	9.5±1(69±7)[93±10]
Rear plate bolt(standard)	M12	1.25	17	28	6.5±1(47±7)[64±10]
Rear plate bolt(stamping)	M8	1.25	12	16	1.15±0.15(8.3±1.1)[11.3±1.5]
Flywheel bolt	M12	1.25	19	29	13.5±0.5(98±4)[132±5]
Oil pan bolt (for tractor engine)	M8	1.25	12	25	2.8±0.3(20.3±2.2)[27.5±3]
Oil pan drain plug	M14	1.5	22	10	4±0.5(29±4)[39±5]
Pressure relief valve	M22	1.5	22	33	5±0.5(36±4)[49±5]
Oil filter	M20	1.5	—	—	1.2±0.1(8.7±0.7)[12±1]
Oil pressure switch	PT1/8	—	26	11	1±0.2(7.2±1.4)[10±2]
Fuel injection pipe nut	M12	1.5	—	—	3±0.5(22±4)[29±5]
Fuel leak0off pipe nut	M12	1.5	18	—	2.75±0.25(20±2)[27±2.5]
Delivery valve holder	—	—	19	—	4.5±0.5(32.5±4)[44±5]
Fuel injection nozzle holder	M20	1.5	21	—	5.5±0.5(40±4)[54±5]
Retaining nut for delivery valve holder body	M16	0.75	19	—	3.75±0.25(27±2)[37±2.5]
Sliding sleeve shaft	M10	1.25	14	29.5	3.6±0.6(26±4)[35±6]
Special nut for torque spring set	M12	1.0	17	—	2±0.5(14±4)[20±5]
Glow plug	M10	1.25	12	60	1.75±0.25(12.7±2)[17.2±2.5]
Glow plug connection plate	M4	0.7	8	—	0.125±0.025(0.9±0.2)[1.2±0.2]
Stop solenoid nut	M30	1.5	36	—	4.5±0.5(32.5±4)[44±5]
Starter B terminal	M8	1.25	12	—	1.1±0.1(8±0.7)[10.8±1]

Tightening Torques for Standard Bolts and Nuts

Unit:N-m{kgf-m}(lbf-ft)

Bolt Sise	4T	7T
M6	———	7.85-9.80{0.8-1.0}(5.8-7.2)
M8	9.80-12.7{1.0-1.3}(7.2-9.4)	14.7-21.6{1.5-2.2}(10.8-15.9
M10	17.7-24.5{1.8-2.5}(13.0-18.1)	29.4-41.2{3.0-4.2}(21.7-30.4)
M12	9.4-41.2{3.0-4.2}(21.7-30.4)	53.9-73.5{5.5-7.5}(39.8-54.2)

Note:

a. The table above applies only to standardized bolts and nuts.
All torques shown assume use of spring washer together with bolts and nuts.
All bolts and nuts appearing in this manual should be tighrened according to this table unless otherwise indicated.

d. Standard bolts and nuts should be tightened in "dry" condition, without lubricaring threads with oils.

Tightening Torques for Standard Eye Bolts(for Dry Condition)

Nominal Diaerer x Thread Pitch mm	Width Across Flars mm(in)	Torque		
		Strength Class: 4r		
		N-m	kgf-m	lbf-ft
M8x1.25	12(0.47)	8±1	8±0.1	5.8±0.7
M10x1.25	14(0.55)	15±2	15±0.2	15±1.4
M12x1.25	17(0.67)	25±3	25±0.3	18.0±2.2
M14x1.5	22(0.87)	34±4	35±0.4	25.3±2.9
M16x1.5	24(0.94)	44±5	4.5±0.5	32.5±3.6
M18x1.5	27(1.06)	74±5	75±0.5	54.2±3.6
M20x1.5	30(1.18)	98±10	10.0±10	72.3±7.2
M24x1.5	36(1.42)	147±15	15.0±1.5	108.5±10.8
M27x1.5	42(1.61)	226±20	23.0±2.0	166.3±14.5

Tightening Torques for Standard Union Nuts(for Dry Condition)

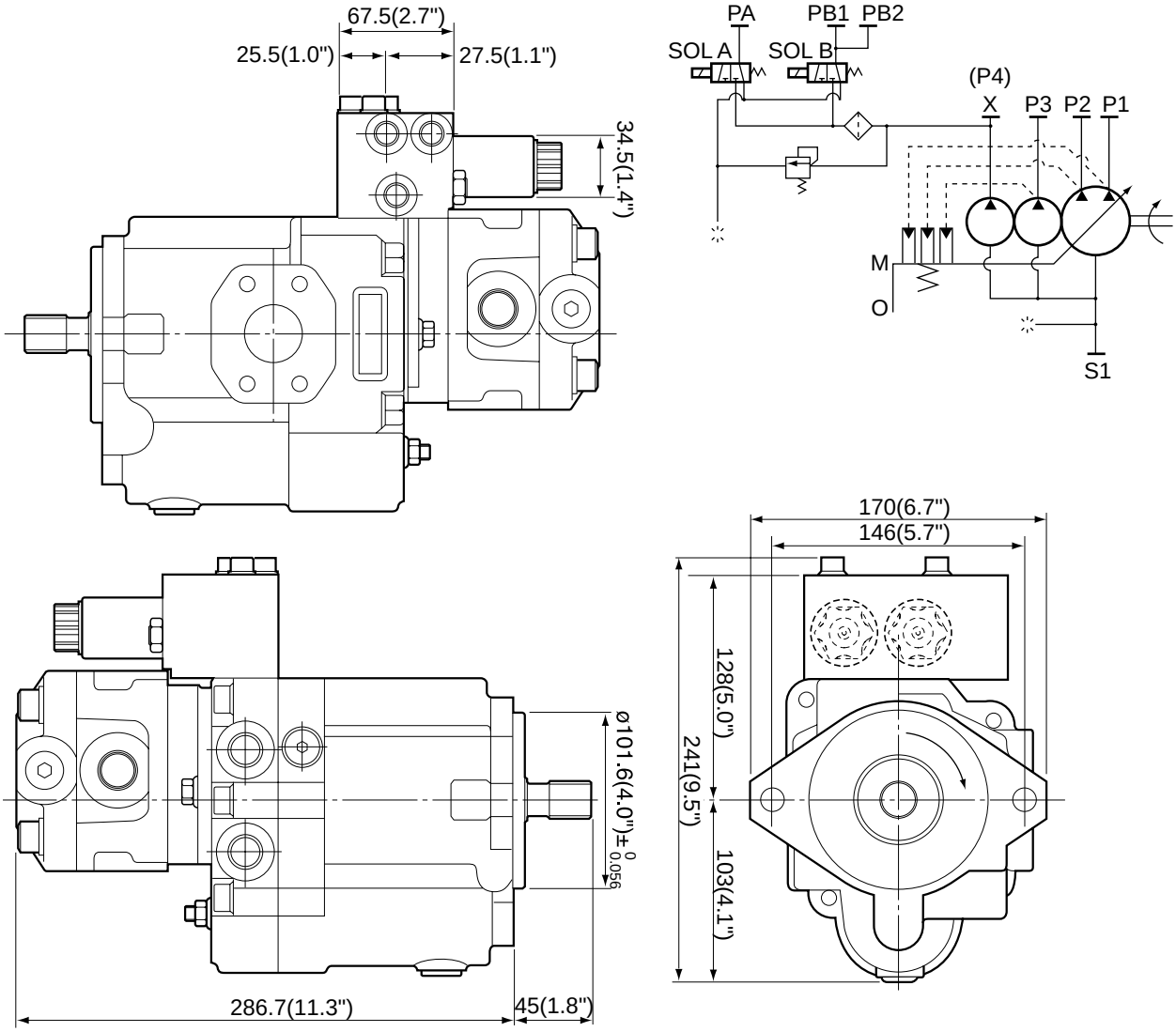
Nominal Diamerer	Internal Nominal Diameter x Thread Pichmm	Width Across Flars mm(in)	N-m	kgf-m	lbf-ft
63	M14x1.5	19(0.7)	39	4	29
80	M16x1.5	22(0.9)	49	5	36
100	M20x1.5	27(1.1)	78	8	58
120	M22x1.5	30(1.2)	98	10	72
150	M27x1.5	32(1.3)	157	16	116
180	M30x1.5	36(1.4)	196	20	145
200	M30x1.5	36(1.4)	196	20	145
220	M33x1.5	41(1.6)	245	25	181
254	M36x1.5	41(1.6)	294	30	217

5 MAIN PUMP

CONTENTS

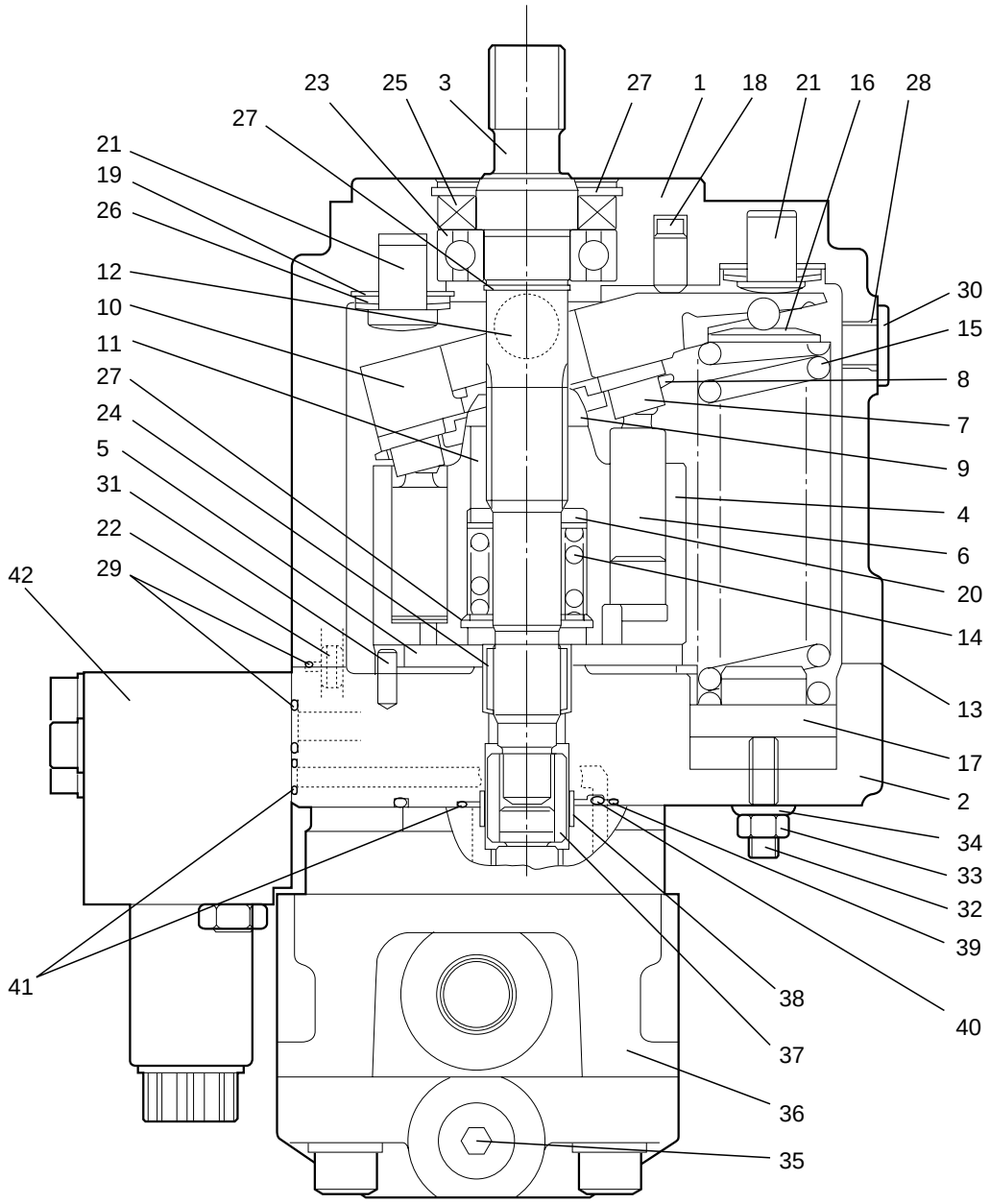
5-1 Specification
5-2 Structure
5-3 Removing and installing the pump
  5-3-1 Removing the pump
  5-3-2 Installing the pump
5-4 Performance test of the hydraulic pump
  5-4-1 Measuring instrument
  5-4-2 Preparation
  5-4-3 Connecting tester
  5-4-4 Measuring procedure
  5-4-5 P-Q characteristic curve

5-1 Specification



Pump type		PVD-1B-32BP-11G5-4608H			
Displacement cc/rev		P1	P2	P3	PA,PB
		16.0	16.0	10.5	4.5
Rated pressure MPa		20.6	20.6	17.2	2.9
Port size	S1	SAE $1^{1}/_{4}$			
	P1,P2,P3	PF $^{1}/_{2}$			
	PA,PB1,PB2	PF $^{1}/_{4}$			
Direction of rotation		Clockwise seen from shaft side			
Weight (kg)		23			

5-2 Structure



1. Body
2. Body
3. Shaft
4. Cylinder
5. Valve plate
6. Piston
7. Shoe
8. Shoe holder
9. Barel holder
10. Swash plate
11. Needle
12. Pin
13. Packing
14. Spring C
15. Spring T1
16. Spring holder
17. Spring guide
18. Rod
19. Washer
20. Retainer
21. Stopper pin
22. Pin
23. Bearing
24. Bearing
25. Oil seal
26. Conical washer
27. Snap ring
28. O-ring
29. O-ring
30. Plug
31. Spring pin
32. Socket head bolt
33. Nut
34. Seal washer
35. Plug
36. Gear pump
37. Coupling
38. Collar
39. O-ring
40. O-ring
41. O-ring
42. Valve assembly

5-3 Removing and installing the pump

5-3-1 Removing the pump

1. Remove the nipple, TEE, elbow and hoses around the pump. Attach a cap to the removed hoses to keep dust off. Store the nipples and elbows in treated oil.

2. Remove the pump mounting bolts(1).

3. Remove the pump from the flange 2. If removal is difficult, insert a screwdriver and remove the pump little by little with equal force applied on the right and left sides.

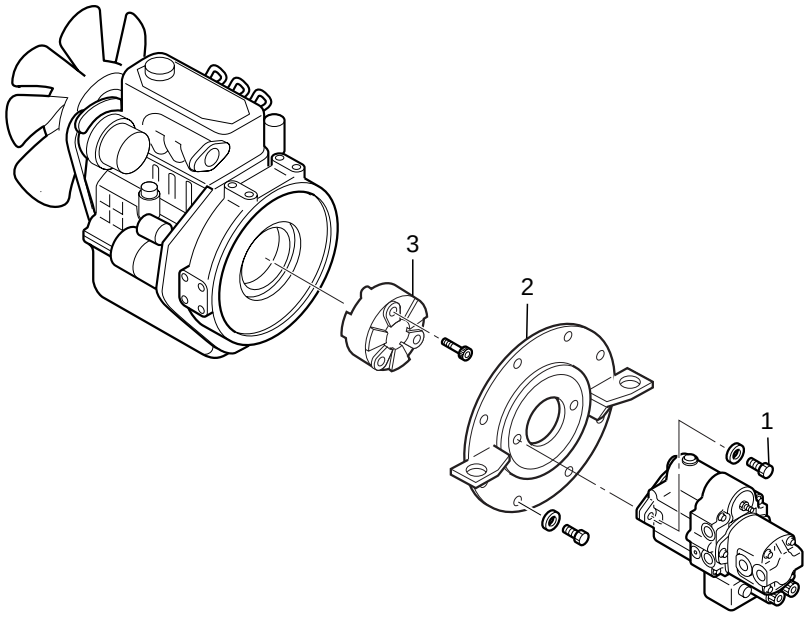
5-3-2 Installing the pump

1. Replace with a new pump and install it on the pump flange 2. Check that the spline of the shaft fits smoothly with the boss of the coupling.
   When tightening the bolts 1, tighten the left and right side bolts slowly and evenly.

Bolt	Tightening torque
M12 × 30ℓ	90~115 N·m

* Precautions on installing the pump

1. Make sure there is no misalignment.



5-4 Performance test of the hydraulic pump

5-4-1 Measuring instrument

Hydraulic pressure tester	Measuring range of flow rate (ℓ/min)	7 ℓ
	Measuring range of pressure (MPa)	0 ~ 34.3
	Measuring range of temperature (°C)	0 ~ 150
	Port size	PF1 O ring type
	Pressure gauge	49 MPa, 4.9 MPa
	Tachometer	Diesel tachometer (digital type)
	Hose for testing	Equivalent to the hose of 20.6 MPa (2,987 psi) high pressure (Nominal size PF1/ 2-PF1/ 2×1m)

5-4-2 Preparation

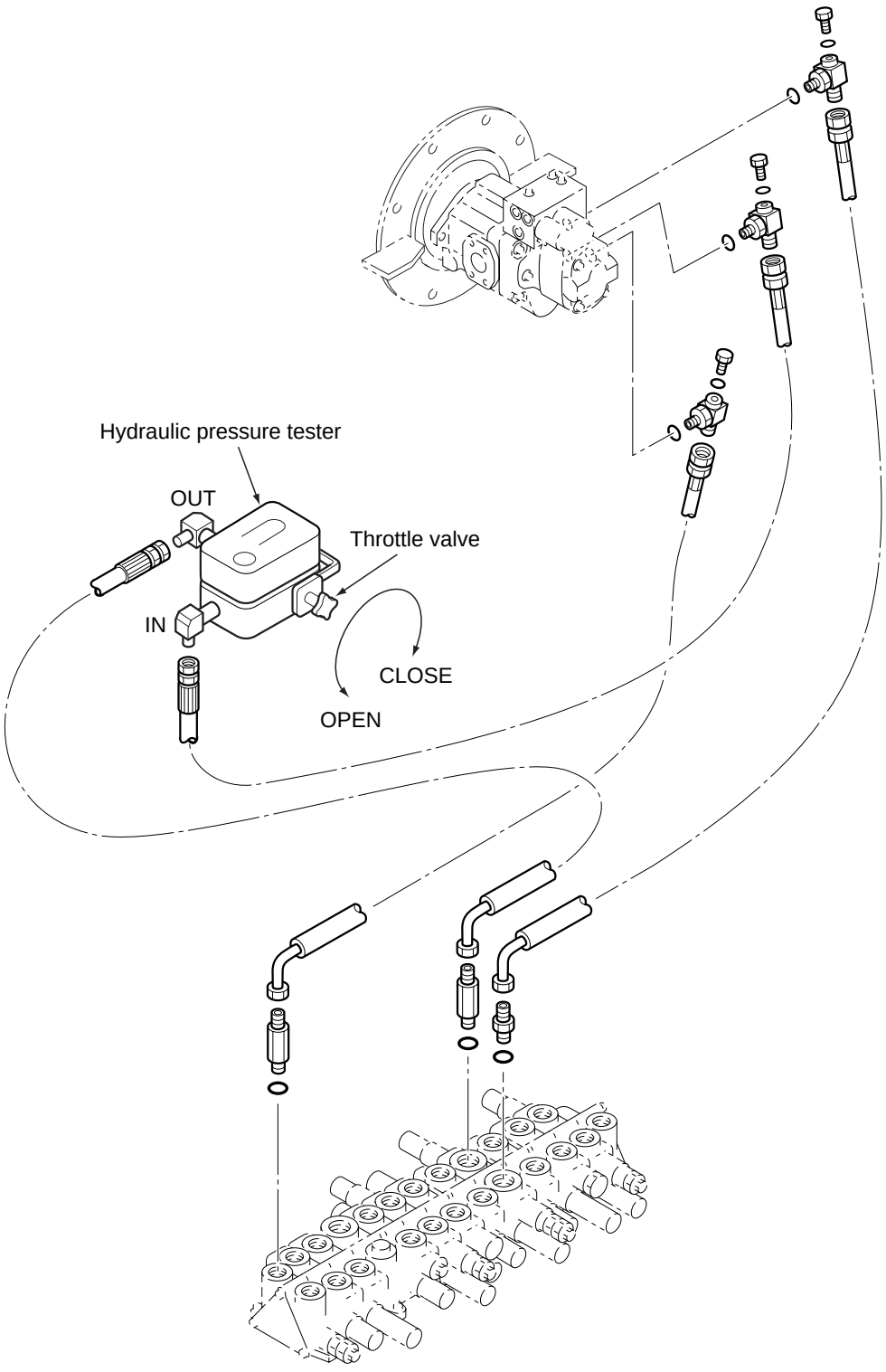
1. Park machine on flat ground and stop engine.

5-4-3 Connecting tester

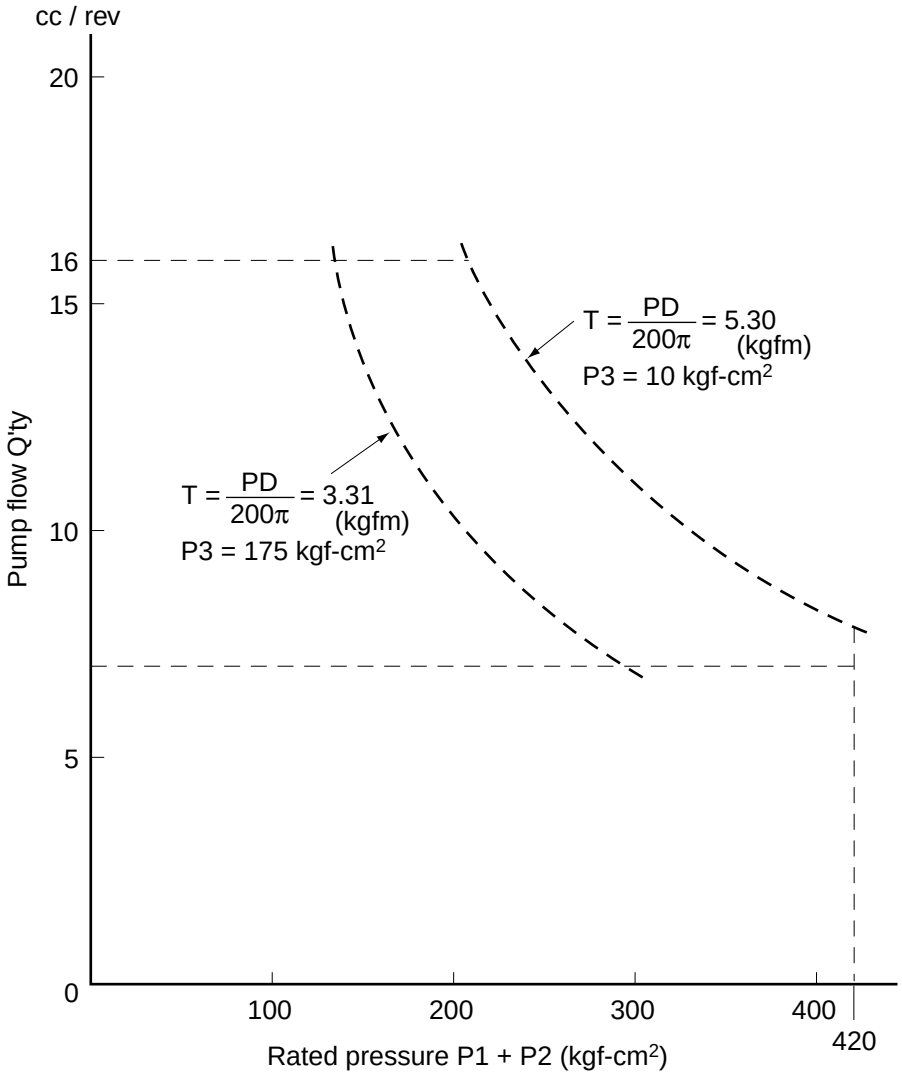
1. Remove the hose on the pump port of the control valve.
2. Connect the removed hose to the outlet of the tester.
3. Connect the hose on the discharge of the pump to the inlet of the tester.
4. Connect pressure gauge to port measuring port.

5-4-4 Measuring procedure

Open the throttle valve of the tester and start the engine. Read the pressures on the pressure gauge and measure the flow at that time. At the same time, record the engine speed.


Hydraulic pressure tester
OUT
Throttle valve
IN
CLOSE
OPEN

5-4-5 H26C Pump Performance P-Q Characteristics



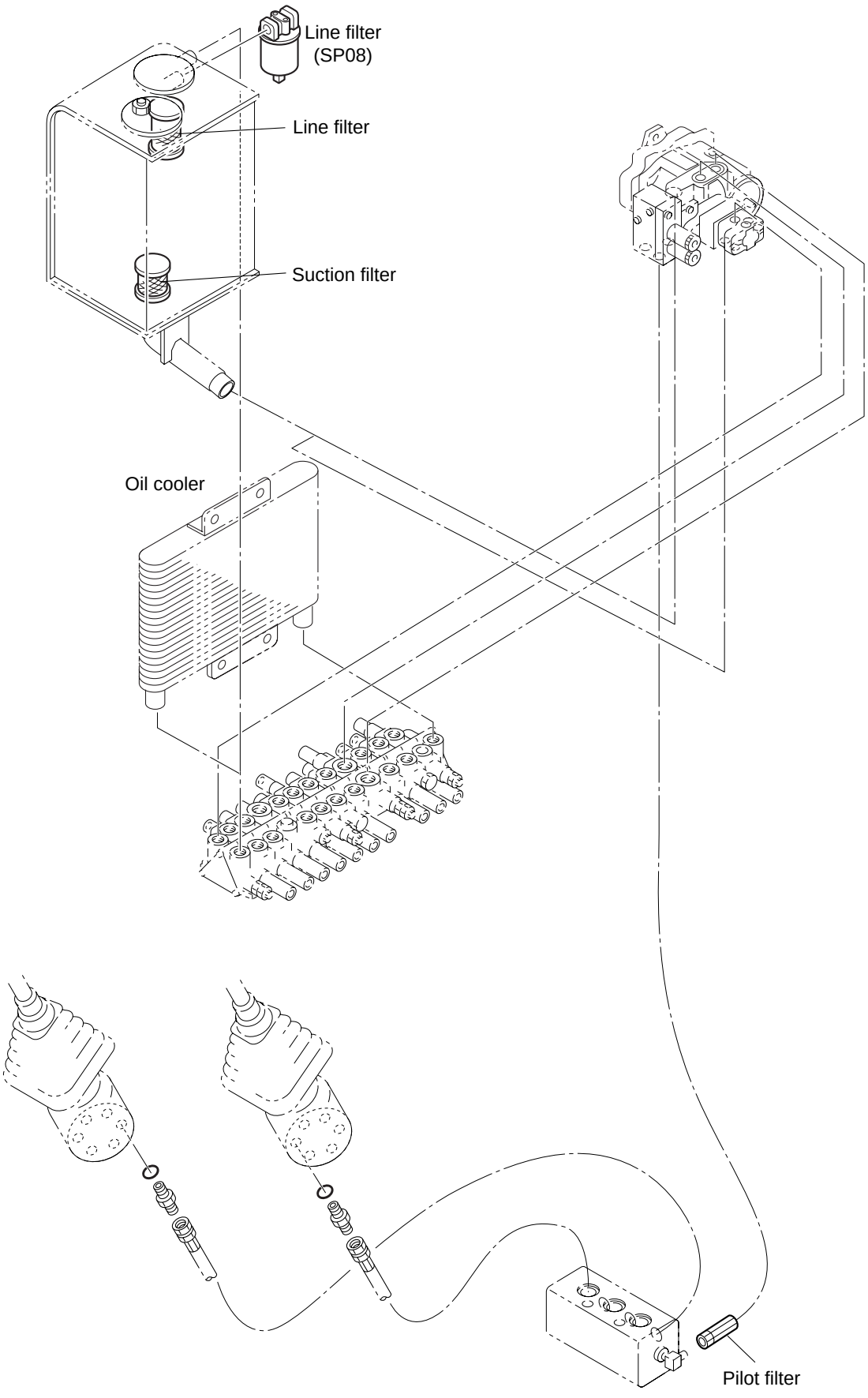
6 HYDRAULIC OIL FILTER

CONTENTS

6-1 Installation
6-2 Hydraulic oil filter
- 6-2-1 Line filter (SP10)
- 6-2-2 Suction filter
- 6-2-3 Pilot filter
- 6-2-4 Line filter(SP08)

6-3 Maintenance procedure
- 6-3-1 Replacing the line filter
- 6-3-2 Replacing the suction filter
- 6-3-3 Replacing the pilot filter
- 6-3-4 How to clean the suction filter

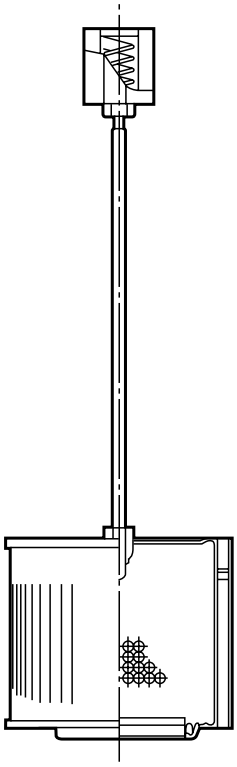
6-1 Installation



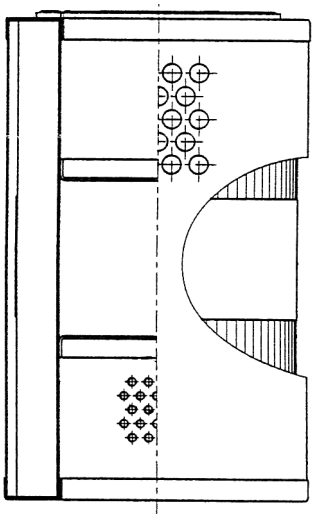
6-2 Hydraulic oil filter

6-2-1 Suction filter

Grain size	150 mesh
Filtration capacity	330ℓ /min(Max)
Oil temperature	-20°C~120°C



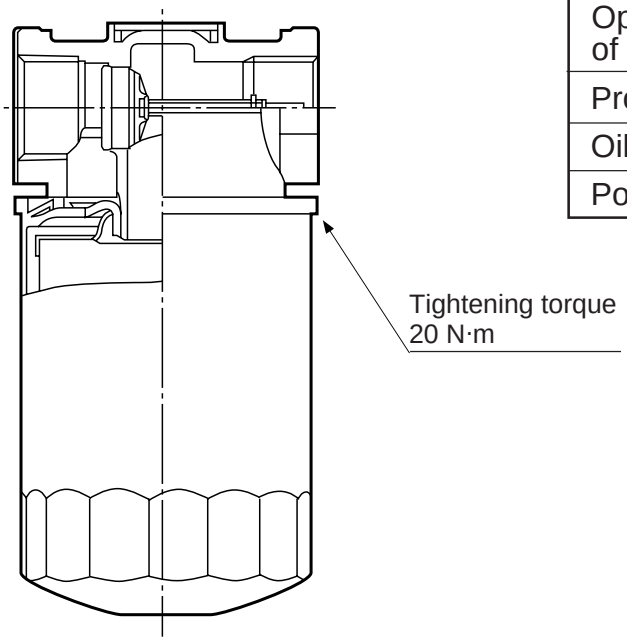
6-2-2 Line filter



Filtration accuracy	10μ
Filtration capacity	125ℓ /min (Max.)
Proof pressure	0.7 MPa
Oil temperature	-20°C~120°C

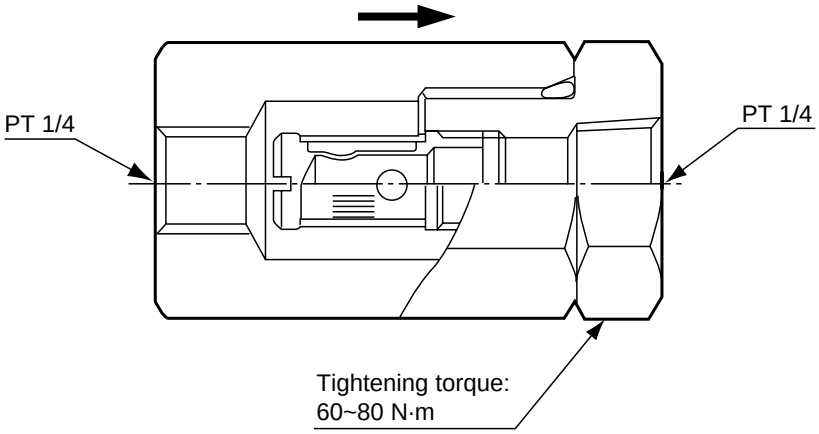
※ Opening pressure of bypass valve (other part) 0.15Mpa

6-2-3 Line filter(only P.T.O return)



Filtration accuracy	10μ
Filtration capacity	125ℓ/min (Max.)
Opening pressure of bypass valve	0.103 MPa
Proof pressure	0.7 MPa
Oil temperature	-20°C~120°C
Port size	2×PT1

6-2-4 Pilot filter



Filtration capacity	2ℓ/min.(Max.)
Proof pressure	3.9 MPa
Filtration accuracy	31 μ
Filtration area	5 cm^2
Oil temperature	-20°C~120°C

6-3 Maintenance procedure

6-3-1 Replacing the line filter

1. Stop the engine.
2. Remove the line filter 6-2-1 with a filter wrench.
3. Check whether any foreign matter is sticking inside the element. If necessary, replace the cartridge assembly.

   * In general, inspect and maintain line filters after the first 100 service hours, then every 500 service hours.

6-3-2 Replacing the suction filter

1. Stop the engine.
2. Remove the bolts and spring washers which retain the filter to the hydraulic oil tank, and pull off the filter.
3. Remove the suction filter to check whether the net of the element is damaged.

   * Replace with a new one if the net is damaged or the mesh is widened.

6-3-3 Replacing the pilot filter

1. Stop the engine.
2. Remove the pilot filter 6-2-3 with a spanner (27 mm(1.06”) width).
3. Remove the filter to check whether the net of the element is damaged.

   * Replace with a new one if the net is damaged or the mesh is widened.

6-3-4 How to clean the suction filter

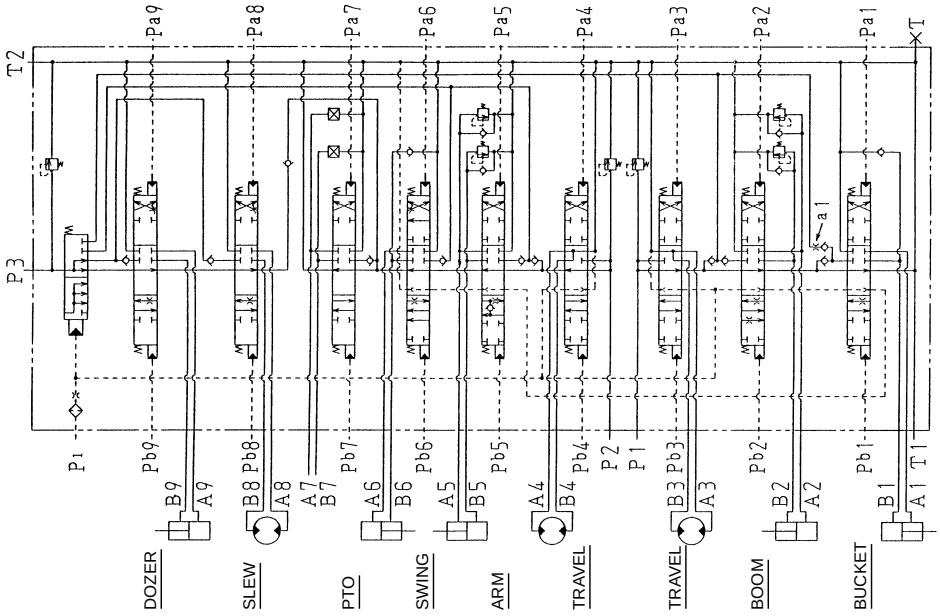
1. Prepare a can with clean treated oil. Immerse the element in it.
2. Using a brush, wash out foreign matter sticking to the element. Use a hard brush if the element is heavily stained.
3. After cleaning, blow compressed air inside the strainer to blow off the treated oil.
4. While cleaning the element, check the hydraulic oil tank at the same time, remove any sediment inside the tank and rinse out the tank.
5. Attach pipes to install the filter to the tank. When installing the filter, fit the O ring in the flange side groove firmly so that hydraulic oil does not leak.
6. Add new hydraulic oil through the hydraulic oil intake.
   Total amount of hydraulic oil : 50.5 ℓ

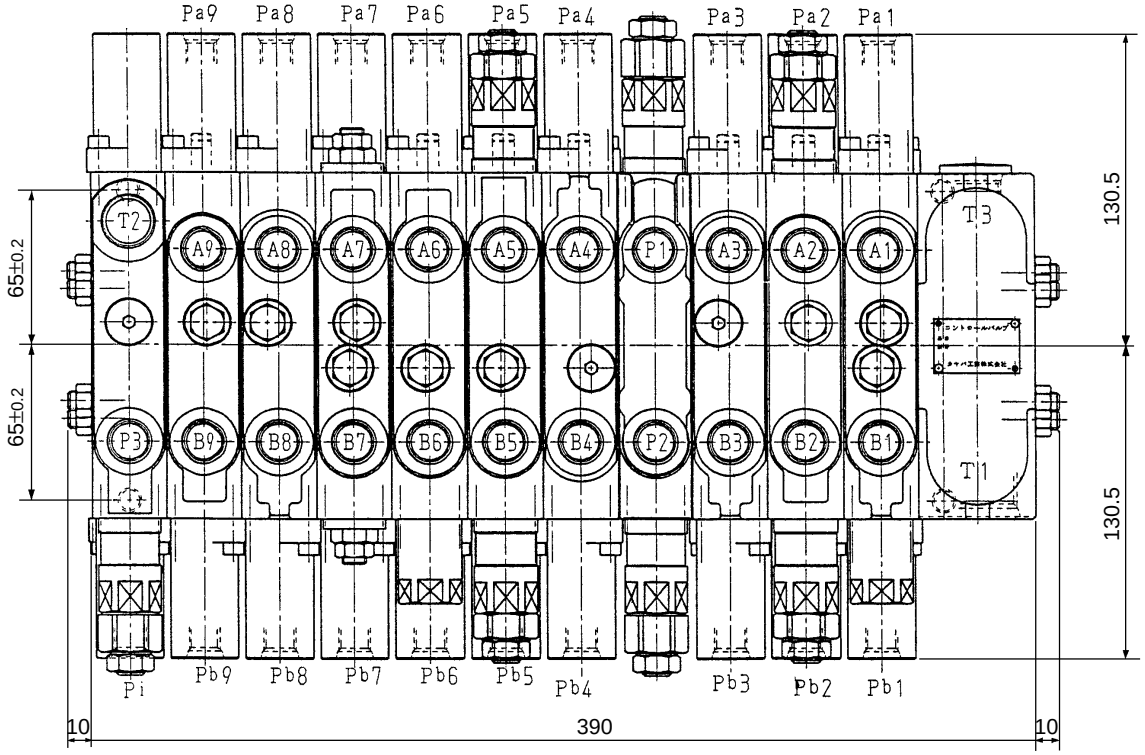
7 CONTROL VALVE

CONTENTS

7-1 Specification
7-2 Disassembly and assembly
  7-2-1 Replacing the O ring on the contact surface and each block assembly
  7-2-2 Replacing the O ring on the Spool
  7-2-3 Removing the load check valve
  7-2-4 Replacing the relief valve assembly and the O ring
7-3 Structure of the relief valve
  7-3-1 Main relief valve
  7-3-2 Port relief valve
7-4 Precautions for handling
  7-4-1 Handling
  7-4-2 Installation
  7-4-3 Operation

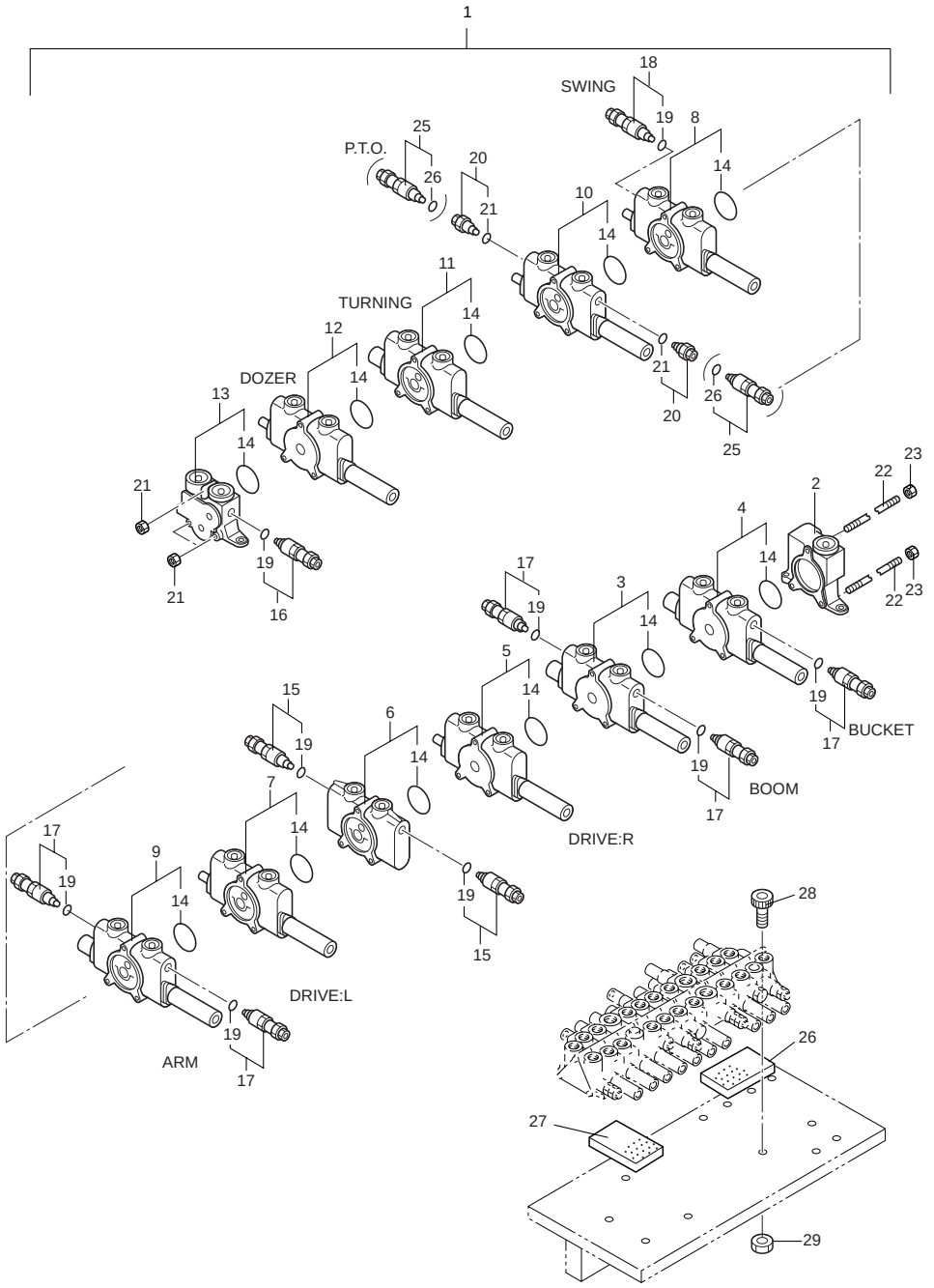
7-1 Specification



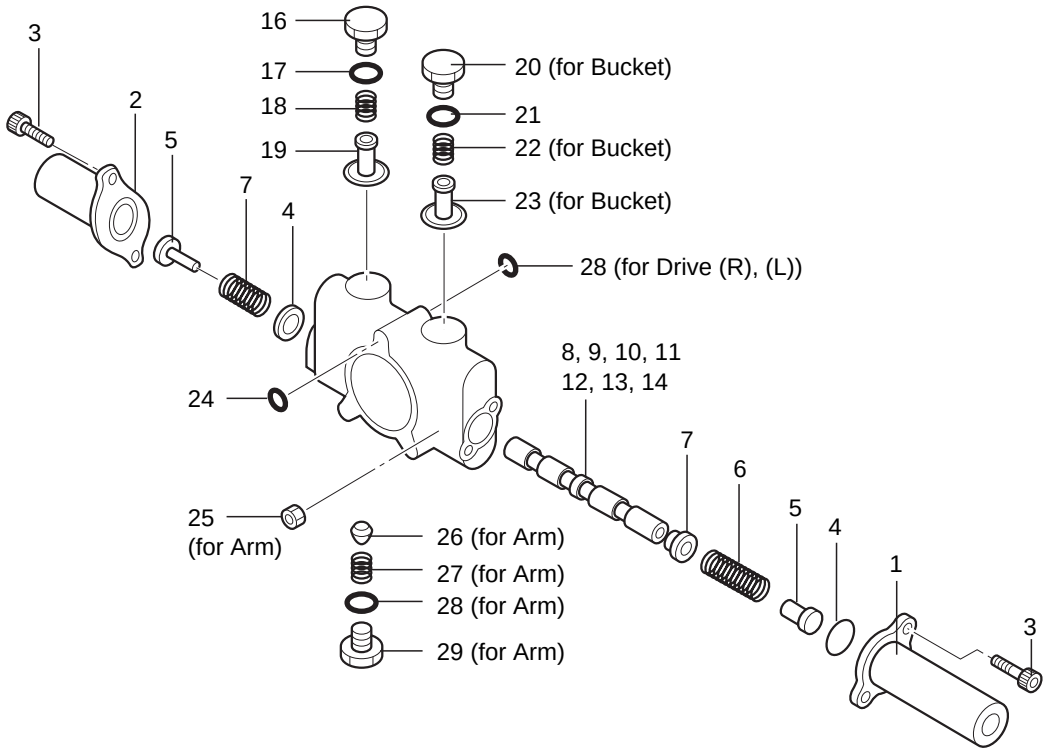


Port size	
P1, P2, P3, T1	PF 1 / 2
T2	PF 3 / 4
A1~A9, B1~B9	PF 3 / 8

P1 and P2 Main relief pressure	20.6 MPa at 42ℓ/min
P3 Main relief pressure	17.2 MPa at 25ℓ/min
A2, B2, A5, B5 Port relief pressure	23.5 MPa at 5ℓ/min



1. CONTROL VALVE ASS'Y
2. OUTLET SECTION ASS'Y
3. BLOCK ASS'Y
4. BLOCK ASS'Y
5. BLOCK ASS'Y
6. SPACER SECTION ASS'Y
7. BLOCK ASS'Y
8. BLOCK ASS'Y
9. BLOCK ASS'Y
10. BLOCK ASS'Y
11. BLOCK ASS'Y
12. BLOCK ASS'Y
13. INLET SECTION ASS'Y
14. O-RING
15. RELIEF VALVE ASS'Y
16. RELIEF VALVE ASS'Y
17. RELIEF VALVE ASS'Y
18. ANTI-VOID VALVE ASS'Y
19. O-RING
20. SHUT OFF VALVE ASS'Y
21. NUT
22. O-RING
23. NUT
24. RELIEF VALVE ASS'Y
25. O-RING
26. MAT(A)
27. MAT(B)
28. BOLT
29. NUT



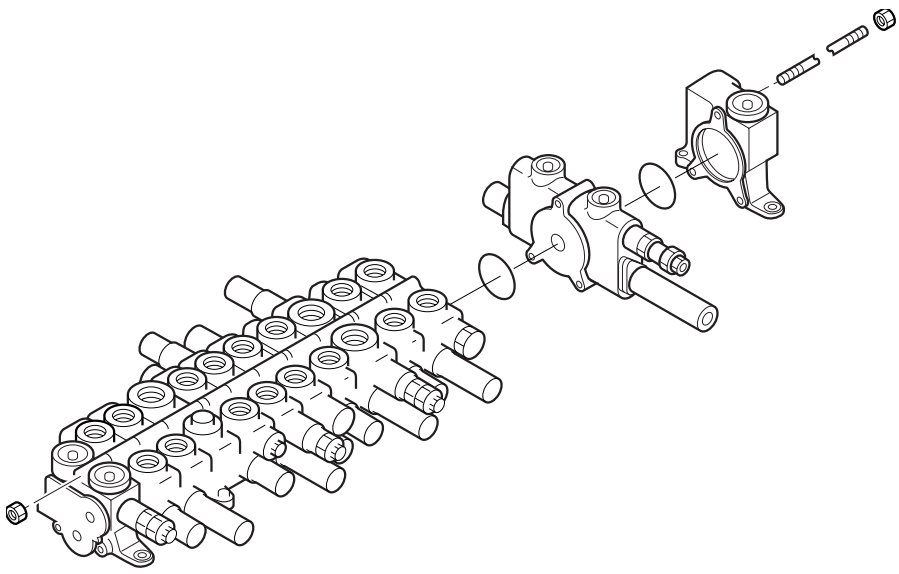
FOR BOOM/BUCKET/SLEW
DRIVE(R)(L)/SWING
P.T.O./DOZER/ARM

1. CAP
2. CAP
3. BOLT, SOCKET HEAD
4. O-RING
5. END, SPOOL
6. SPRING
7. SEAT, SPRING
8. SPOOL
9. SPOOL
10. SPOOL
11. SPOOL
12. SPOOL
13. SPOOL
14. SPOOL
15. SPOOL
16. PLUG
17. O-RING
18. SPRING
19. POPPET
20. PLUG
21. O-RING
22. SPRING
23. POPPET
24. O-RING
25. ORIFICE
26. POPPET
27. SPRING
28. O-RING
29. SPRING
30. PLUG
31. SEAT, SPRING
32. SPOOL

7-2 Disassembly and assembly

7-2-1 Replacing the O ring on the contact surface and each block assembly

1. Loosen the nut of tie rod.
2. Remove each block. Be careful not to damage the machine contact surface.
3. When disassembled, it is recommended to replace the O rings on the contact surface.
4. When assembling, clean the contact surface so that no dust sticks to the surface. Then attach the O ring and reassemble in the reverse order of the above procedure. When attaching the O ring, give grease to it.
5. Tighten nut temporarily.
6. After tightening, place them on their side. Pressing the inlet cover and end cover from above, check the level of the mounting legs and tighten the nut.
   The tightening torque of the tie rod nut is 24 N·m. While tightening them, check that the Spool of each block operates smoothly.



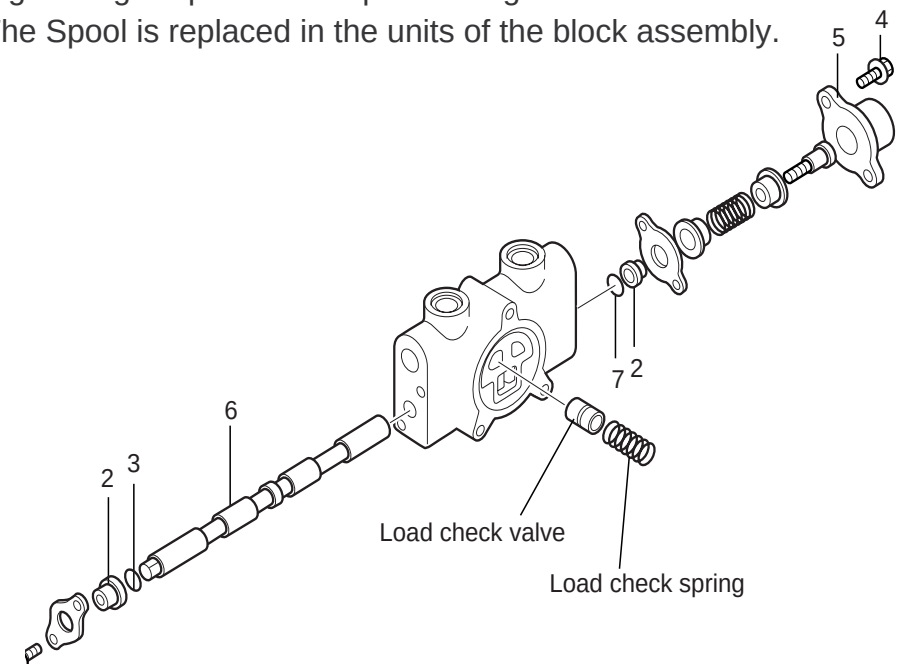
7-2-2 Replacing the O ring on the Spool

1. On the lever side

   1) Remove the mounting screws (1) of the O-ring presser from the block.
   2) Replace the backup ring (2) and O-ring (3).
   3) When mounting the O-ring presser, be sure not to damage the O-ring.

2. On the cap side

   1) Loosen the cap mounting screws (4) and remove the cap (5).
      Take out Spool (6) and replace O-ring (7)
   2) Rinse the Spool and insert it in the body.
   3) When installing the spring cap, be careful not to damage the O-ring.
      Tightening torque of the cap mounting screw is 9 N·m.
      The Spool is replaced in the units of the block assembly.



7-2-3 Removing the load check valve (For Drive (R), (L))

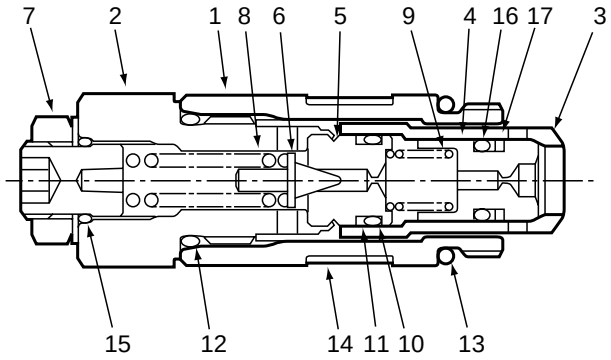
1. Remove the load check spring and load check valve from the valve block.
2. Keep each load check valve in order so as not to confuse it with other valve block.
2. Clean the parts sufficiently before assembling them.

7-2-4 Replacing the relief valve assembly and the O-ring.

1. Remove the inlet section assembly and the relief valve.
2. If necessary, replace the O-ring or the relief valve assembly.
3. During installation, give grease to the O-ring.
4. When the relief set, cap nut of adjusting screw and hexagon nut are loosened, always check relief set pressure using the pressure gauge.
   At this time, the relief set pressure and flow rate shall be conformed to the specification indicated on the page of external drawing.
5. When the relief valve assembly is removed, check whether the small hole on the center of relief piston is clogged with foreign matter.

7-3 Structure of the relief valve

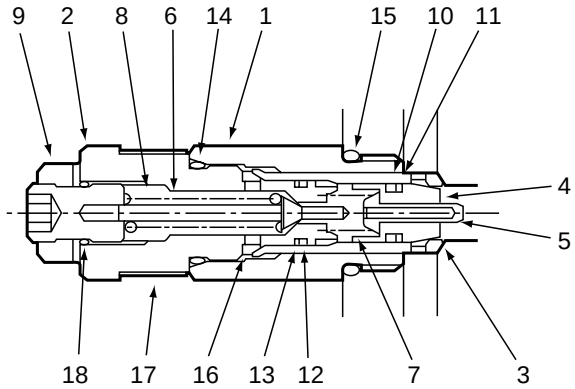
7-3-1 Main relief valve



Part	Tightening torque
Cap nut	30 N·m
Installation of the relief valve	70 N·m

1. Cap
2. Plug
3. Sleeve
4. Main poppet
5. Pilot sheet
6. Pilot poppet
7. Adjuster kit
8. Pilot spring
9. Spring
10. O-ring
11. Backup ring
12. O-ring
13. O-ring
14. Name plate
15. O-ring (1B-P10)
16. O-ring
17. Backup ring

7-3-2 Port relief valve



Part	Tightening torque
Cap nut	30 N·m
Installation of the relief valve	70 N·m

1. Cap
2. Plug
3. Poppet
4. poppet
5. Piston
6. Pilot poppet
7. Spring
8. Pilot spring
9. Adjuster kit
10. O-ring
11. Backup ring
12. O-ring
13. Backup ring
14. O-ring
15. O-ring
16. Wave washer
17. Name plate
18. O-ring (1B-P10)

7-4 Precautions for handling (Installation and operation should conform to the following items.)

7-4-1 Handling

When handling and carrying valves, be careful neither to drop them nor bang the spool end and cap.

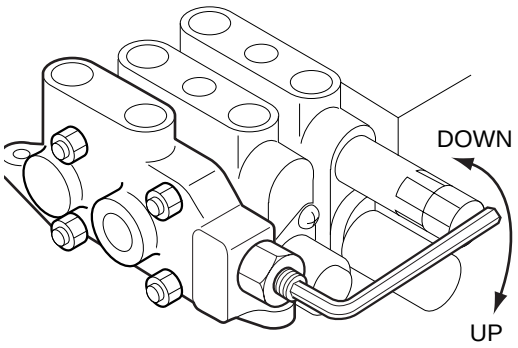
When stocking a valve for a long time, plug each port to prevent dust and water from entering it.

7-4-2 Installation

1. Tighten the valve joints with the specified tightening torque. Be careful so that no unnecessary force acts on the valve through the piping.
2. Install the operation link so that the spool moves correct in the direction of shaft.
3. Be careful when welding near a valve, because the high temperature and spatter may damage the O ring of the spool and the dust seal.
4. Do not paint the spool.
5. Never remove the plug on each port to prevent dust from entering until piping work begins.

7-4-3 Operation

1. Before operation, check that the hydraulic circuit and the oil are both clean (cleanliness of hydraulic oil must be higher than the NAS12 class).
2. Keep the oil temperature between -20°C and 80°C. If the temperature falls below 0°C, warm up the machine.
3. Never raise the set pressure of the main relief valve and port relief valve beyond the specified set pressure. If the set pressure differs from the specified value, adjust it in the following manner.
   1) Procedure for adjusting the main relief valve:
      a. Install a pressure gauge between the pump and control valve in the measuring position. If there is a mounting hole for the pressure gauge, use it.
      b. Raise the temperature of the hydraulic oil to 50 to 60°C and set the engine speed to the rated value.
      c. Operate the control lever to read the indication of the pressure gauge when cylinder reaches the stroke end.
      d. When raising the pressure, remove the cap nut and turn adjusting screw of the relief valve installed on the inlet section clockwise with an Allen wrench.



Relief valve pressure adjustment	
Main relief valve	Approx. 17.7 MPa per rotation
Port relief valve	Approx. 15.7 MPa per rotation

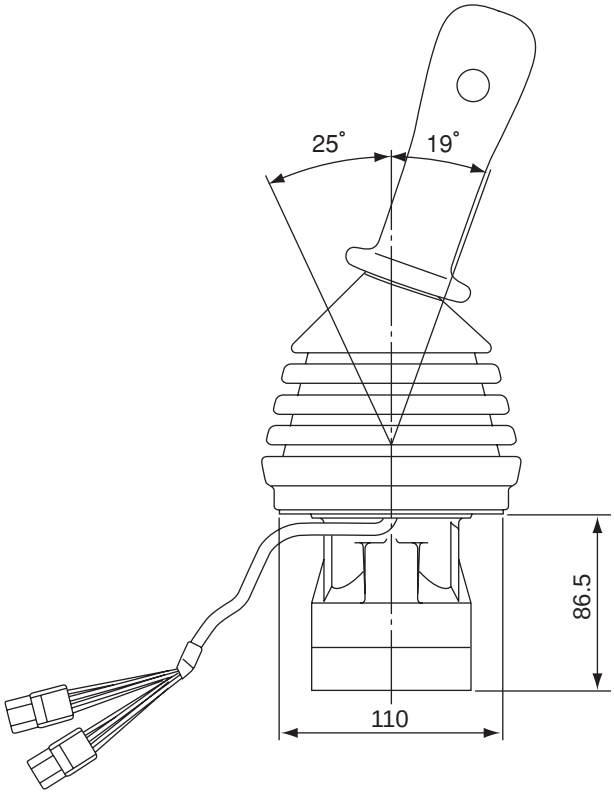
      e. Always lock the valve when it is set to the specified pressure.

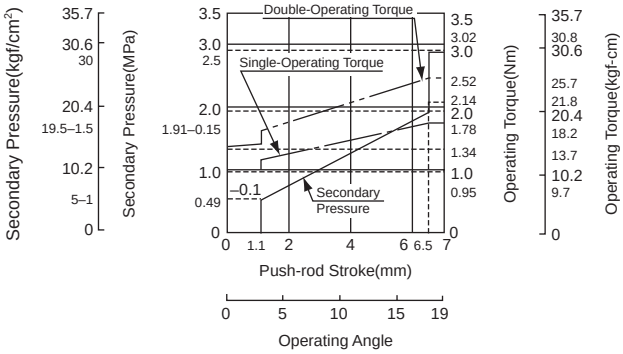
8 JOYSTICK (PILOT VALVE)

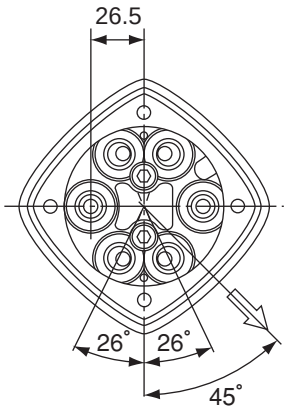
CONTENTS

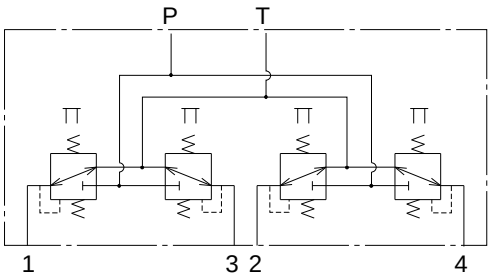
8-1 Specification
8-2 Structure

8-1 Specification

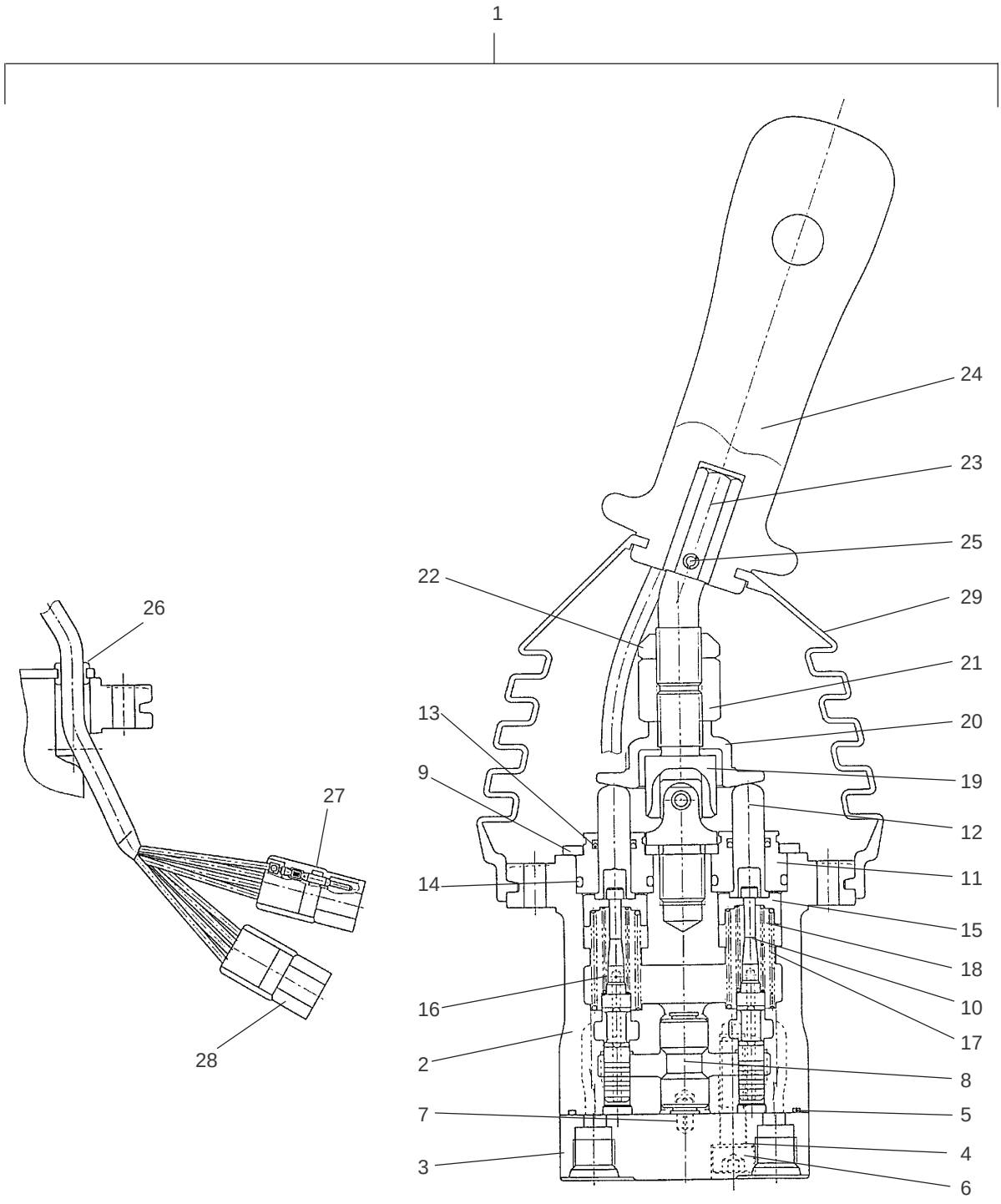








8-2 Structure



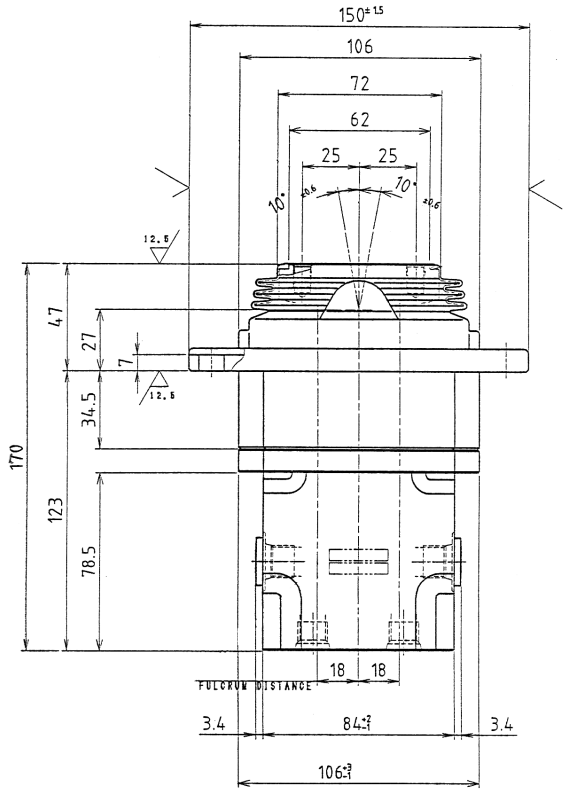
1. JOYSTICK VALVE ASS'Y
2. CASING
3. PORT PLATE
4. SEAL WASHER
5. O-RING
6. HEX. BOLT
7. SPRING PIN
8. BUSH
9. PLATE
10. SPOOL
11. PLUG
12. PUSH ROD
13. SEAL
14. O-RING
15. SPRING SEAT
16. WASHER 2
17. SPRING
18. SPRING
19. JOINT
20. CIRCULAR PLATE
21. ADJUSTING NUT
22. LOCK NUT
23. LEVER
24. KNOB
25. SPRING PIN
26. BUSH
27. CONNECTOR
28. HOUSING(4P)
29. BELLOWS

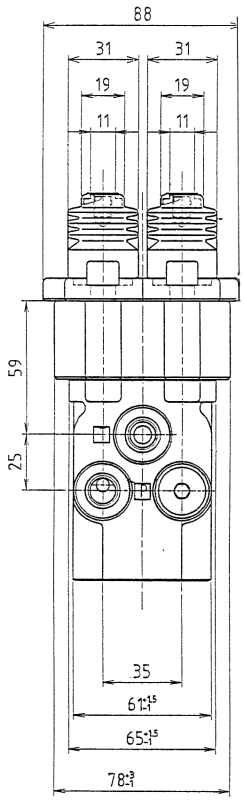
9 PILOT VALVE(1) (TRAVEL)

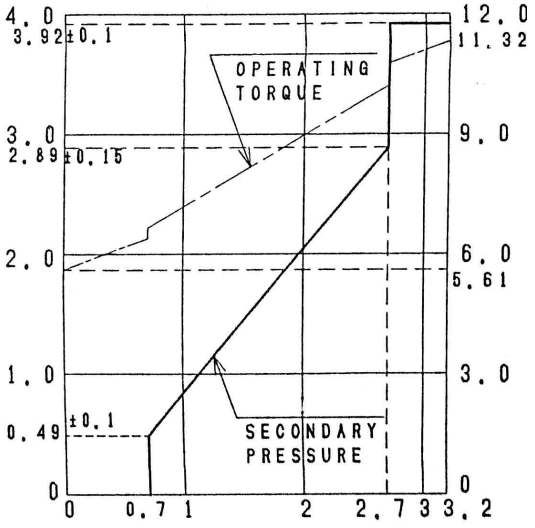
CONTENTS

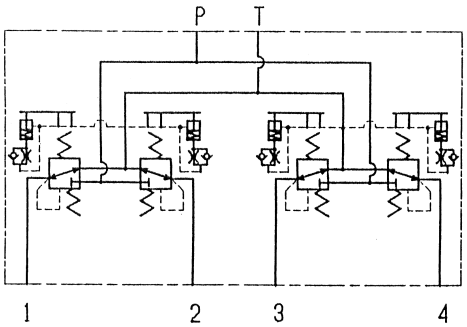
9-1 Specification
9-2 Structure

9-1 Specification

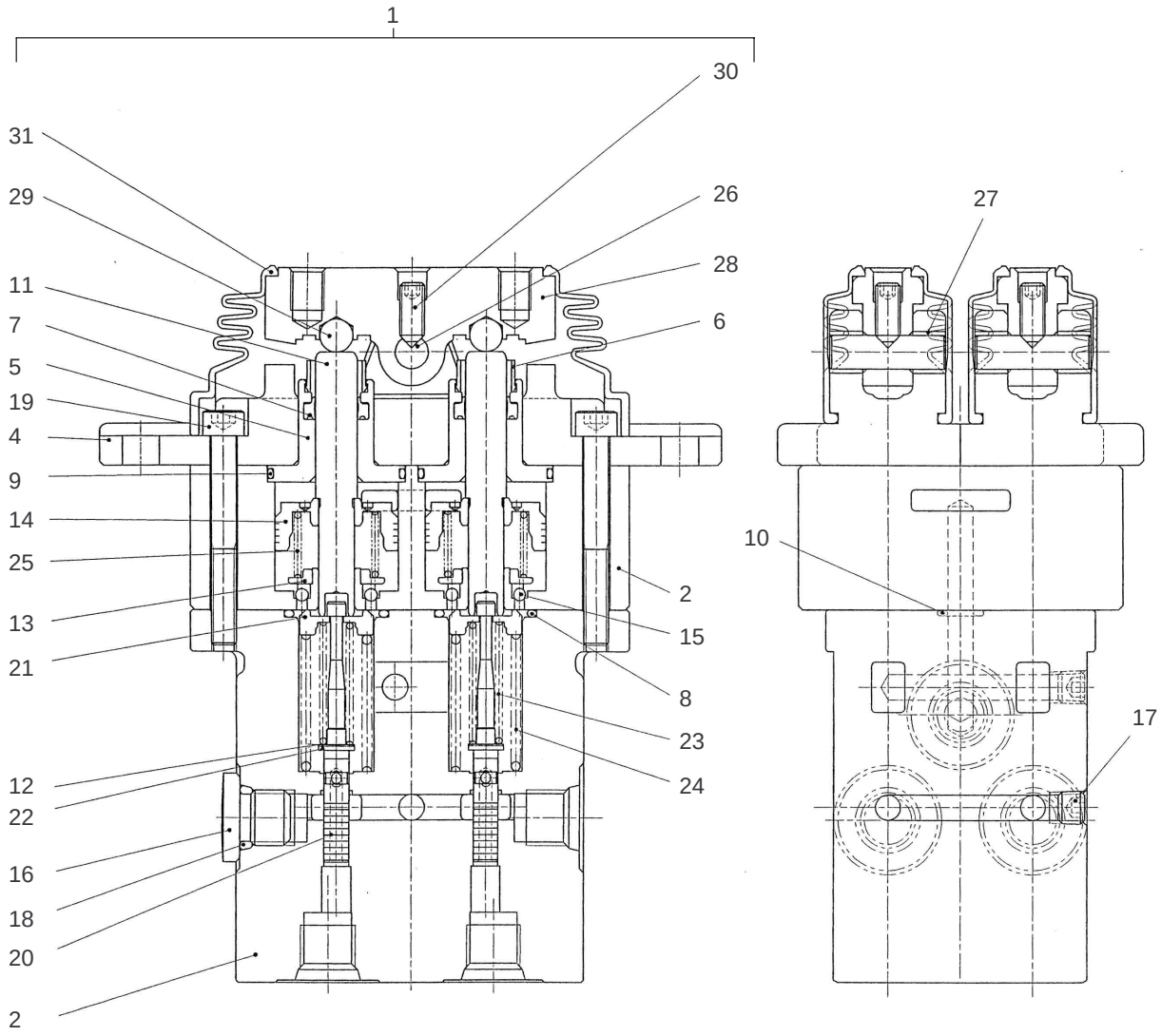








9-2 Structure



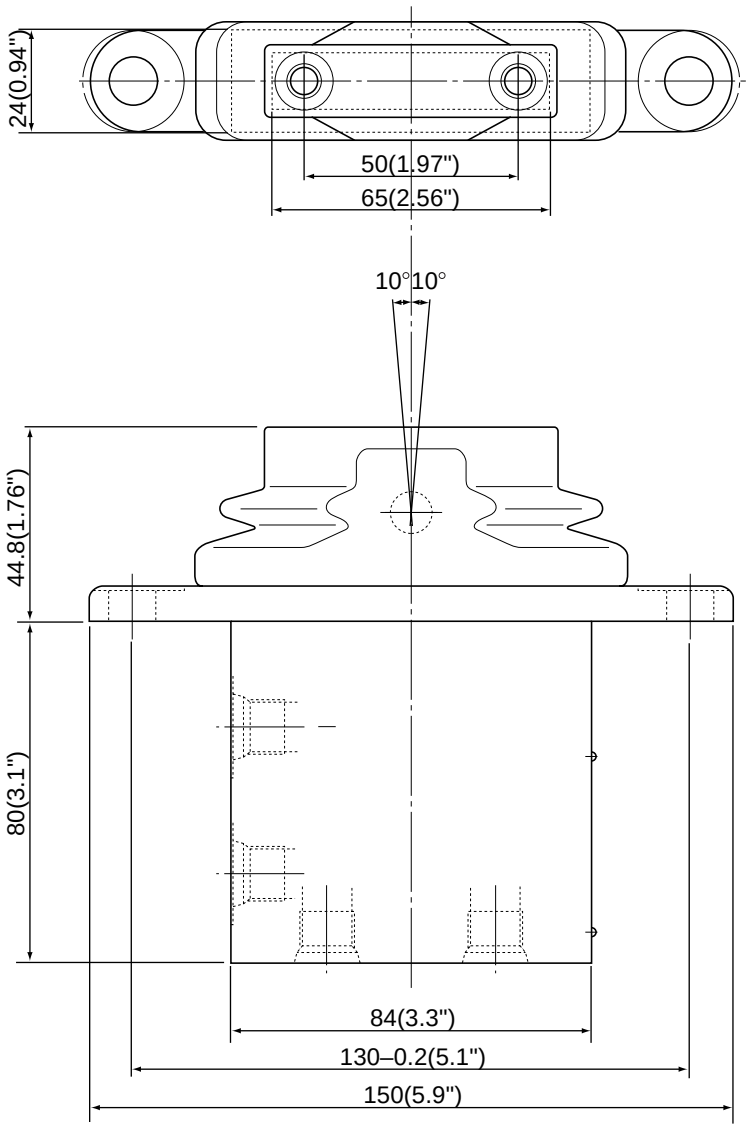
1 PILOT VALVE ASS'Y
2 CASING
3 CASING(DAMPER)
4 COVER
5 PLUG
6 GREASE CAP
7 PACKING
8 O-RING
9 O-RING
10 O-RING
11 ROD, PUSH
12 SHIM
13 SEAT, SPRING
14 PISTON
15 BALL, STEEL
16 RO PLUG
17 PLUG
18 O-RING
19 SCREW, HEX., S.H.C
20 SPOOL
21 SEAT, SPRING
22 WASHER
23 SPRING
24 SPRING
25 SPRING
26 CAM SHAFT
27 BUSH
28 CAM
29 BALL, STEEL
30 SET SCREW
31 BELLOWS

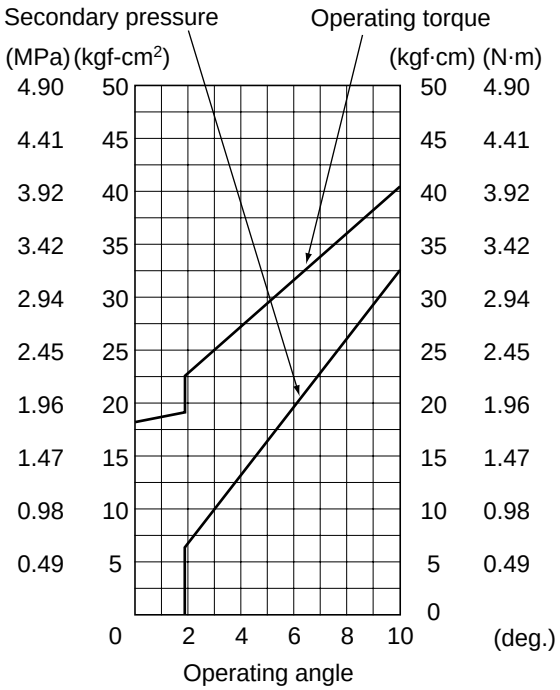
10 PILOT VALVE(2) (SWING · PTO)

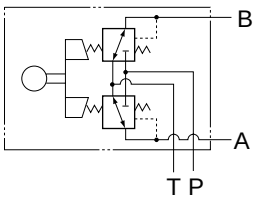
CONTENTS

10-1 Specification
10-2 Structure

10-1 Structure

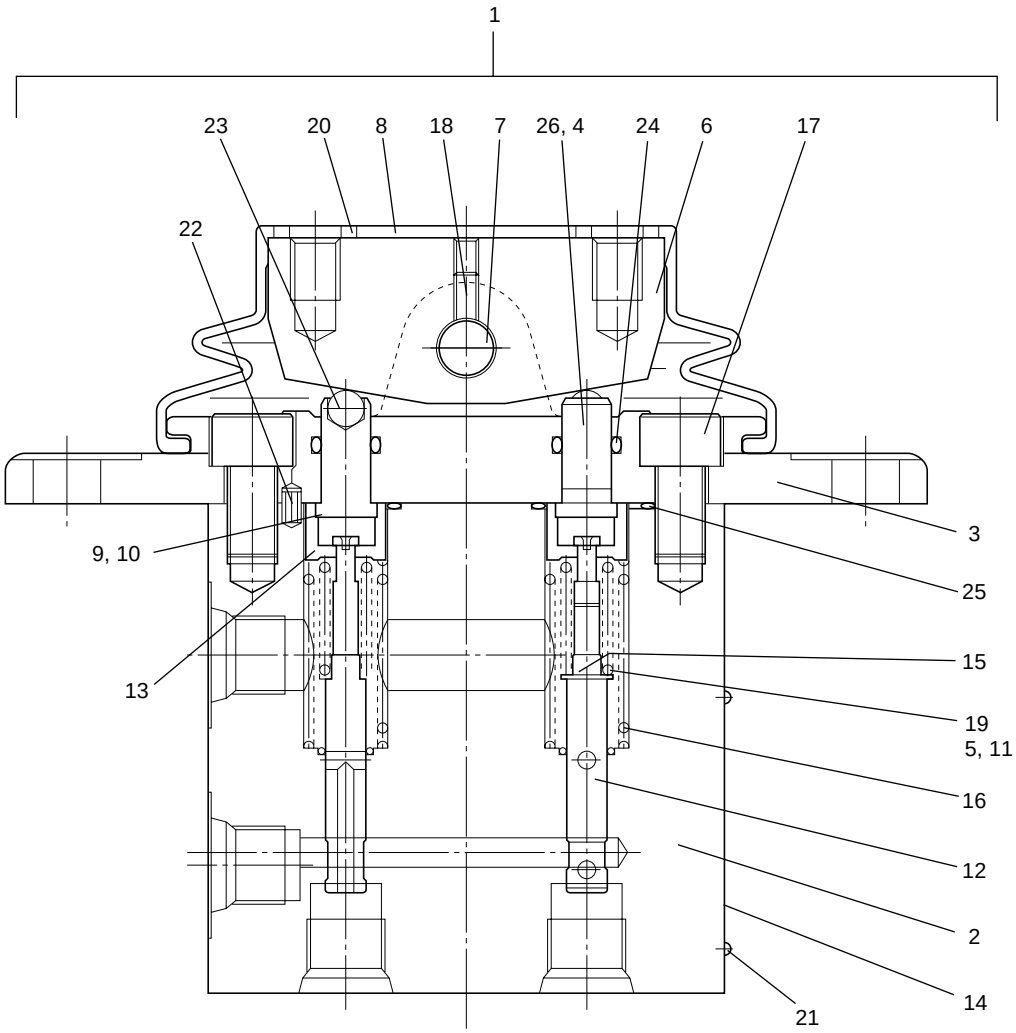






Circuit diagram

10-2 Structure



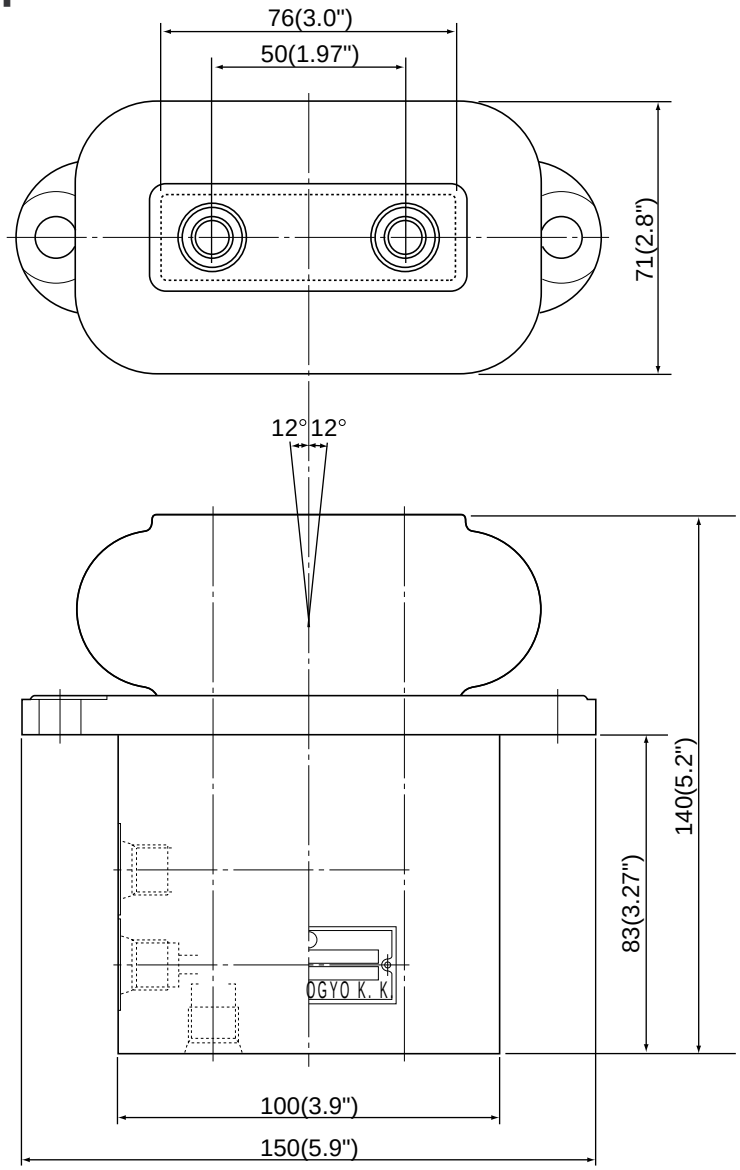
1	PILOT VALVE	14	PLATE, NAME
2	BODY	15	SPRING, COMP
3	COVER	16	SPRING, COMP
4	PUSHER	17	BOLT
5	SHIM	18	SCREW
6	CAM	19	WASHER
7	PIN	20	WASHER
8	BOOT	21	SCREW
9	SHIM	22	PIN, SPRING
10	SHIM	23	STEEL BALL
11	SHIM	24	O-RING
12	SPUR	25	O-RING
13	HOLDER, SPRING	26	PUSHER ASS'Y

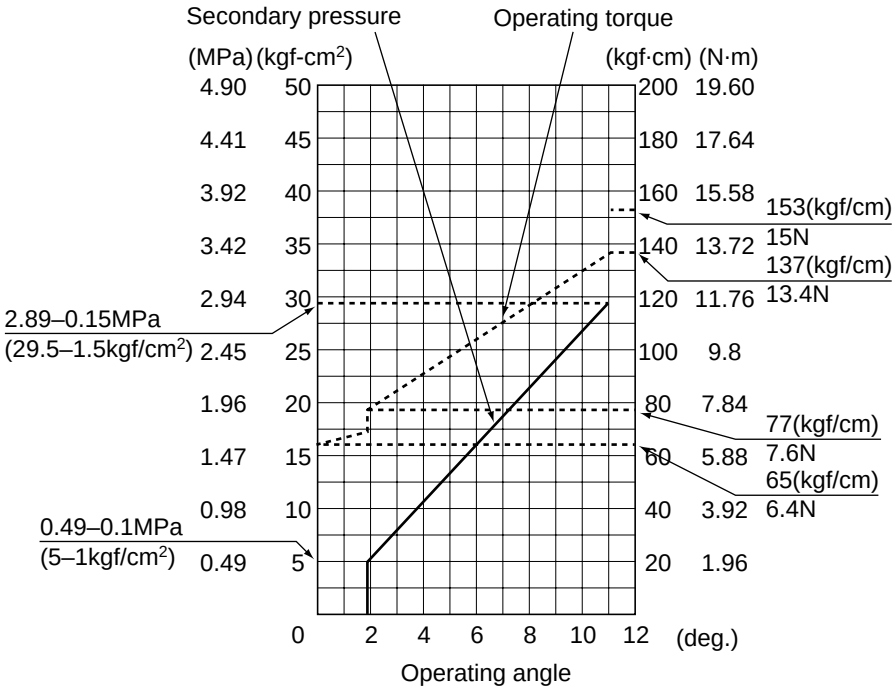
11 PILOT VALVE(3) (DOZER)

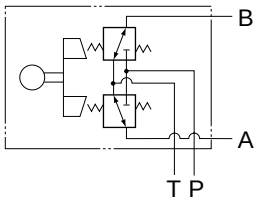
CONTENTS

11-1 Specification
11-2 Structure

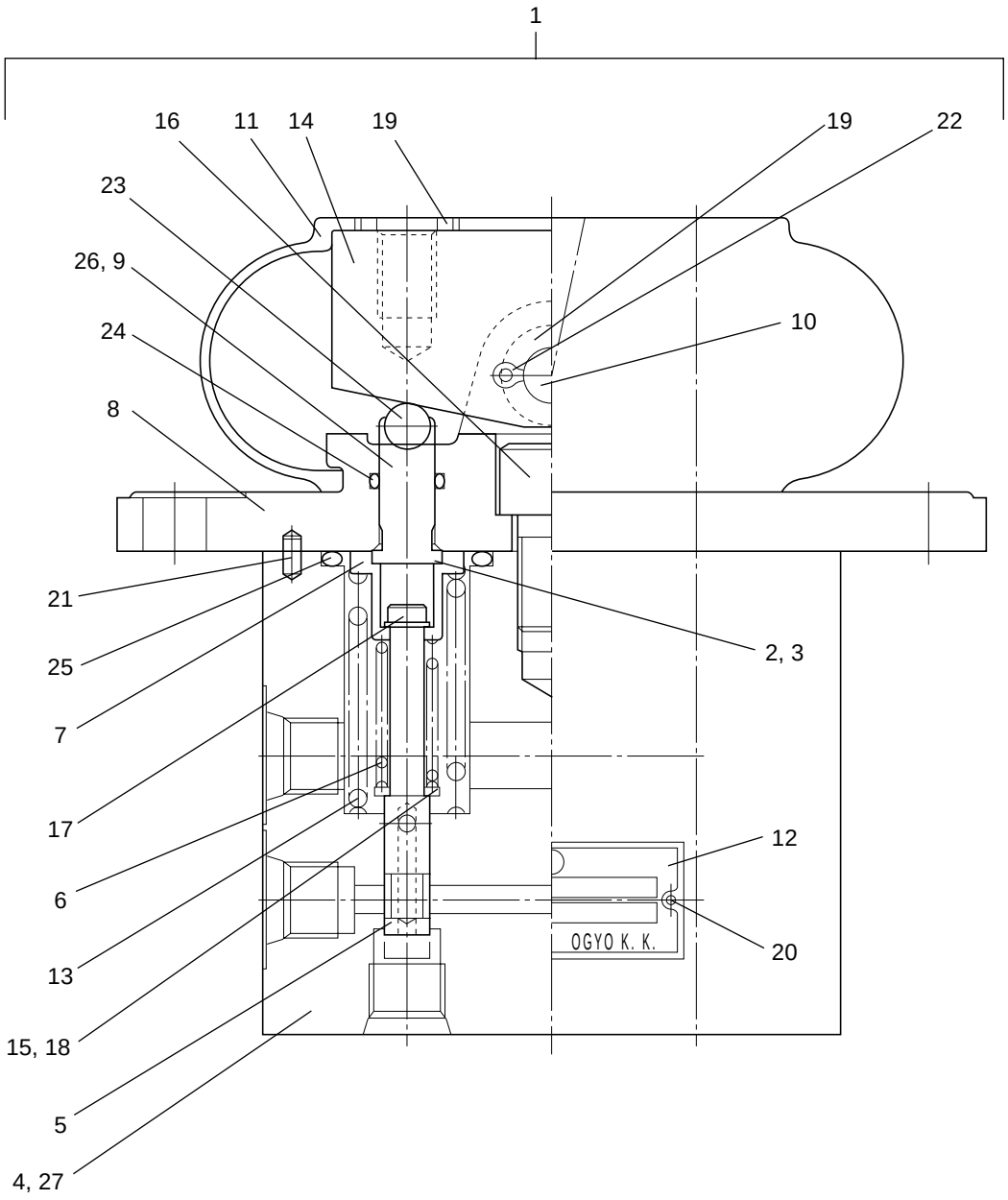
11-1 Specification







11-2 Structure



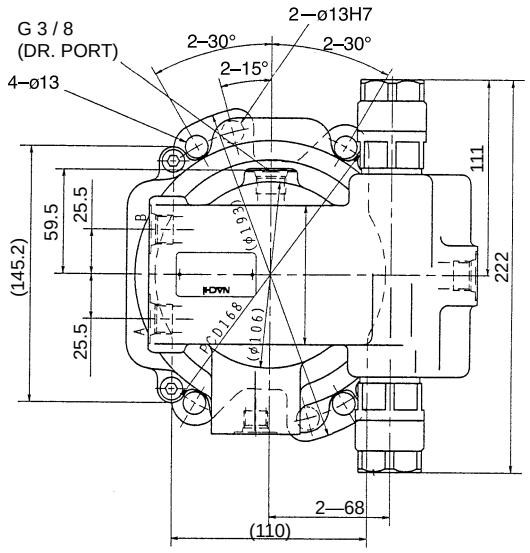
1	DOZER PILOT VALVE	15	SHIM
2	SHIM	16	BOLT
3	SHIM	17	BOLT
4	BODY	18	WASHER
5	SPOOL	19	WASHER
6	SPRING COMP	20	SCREW
7	SLEEVE	21	SPRING PIN
8	COVER	22	PIN
9	PUSHER	23	STEEL BALL
10	PIN	24	O-RING
11	BOOT	25	O-RING
12	PLATE, NAME	26	PUSHER ASS'Y
13	SPRING COMP	27	BODY ASS'Y
14	CAM		

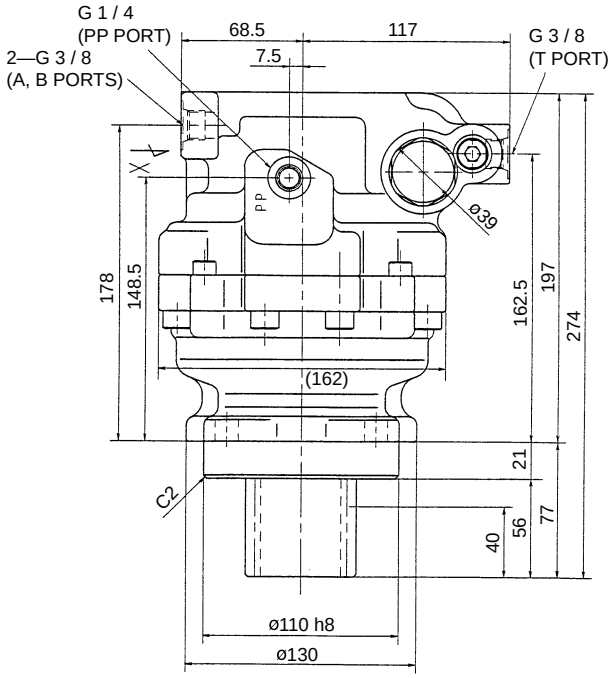
12 SLEW MOTOR

CONTENTS

12-1 Specification
12-2 Structure
12-3 Standard of maintenance
  12-3-1 Slew bearing & slew case
12-4 Inspection and adjustment
  12-4-1 Measuring the natural slew distance
  12-4-2 Measuring the over slew distance after stopping
  12-4-3 Measuring the required time for slewing

12-1 Specification



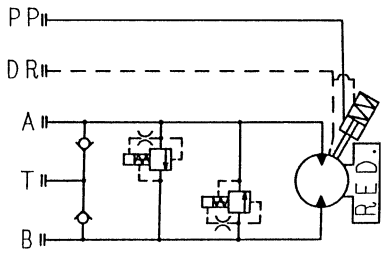


Direction of rotation
(seen from the output shaft)

Direction of rotation	Oil inlet	Oil outlet
Clockwise	A	B
Counterclockwise	B	A

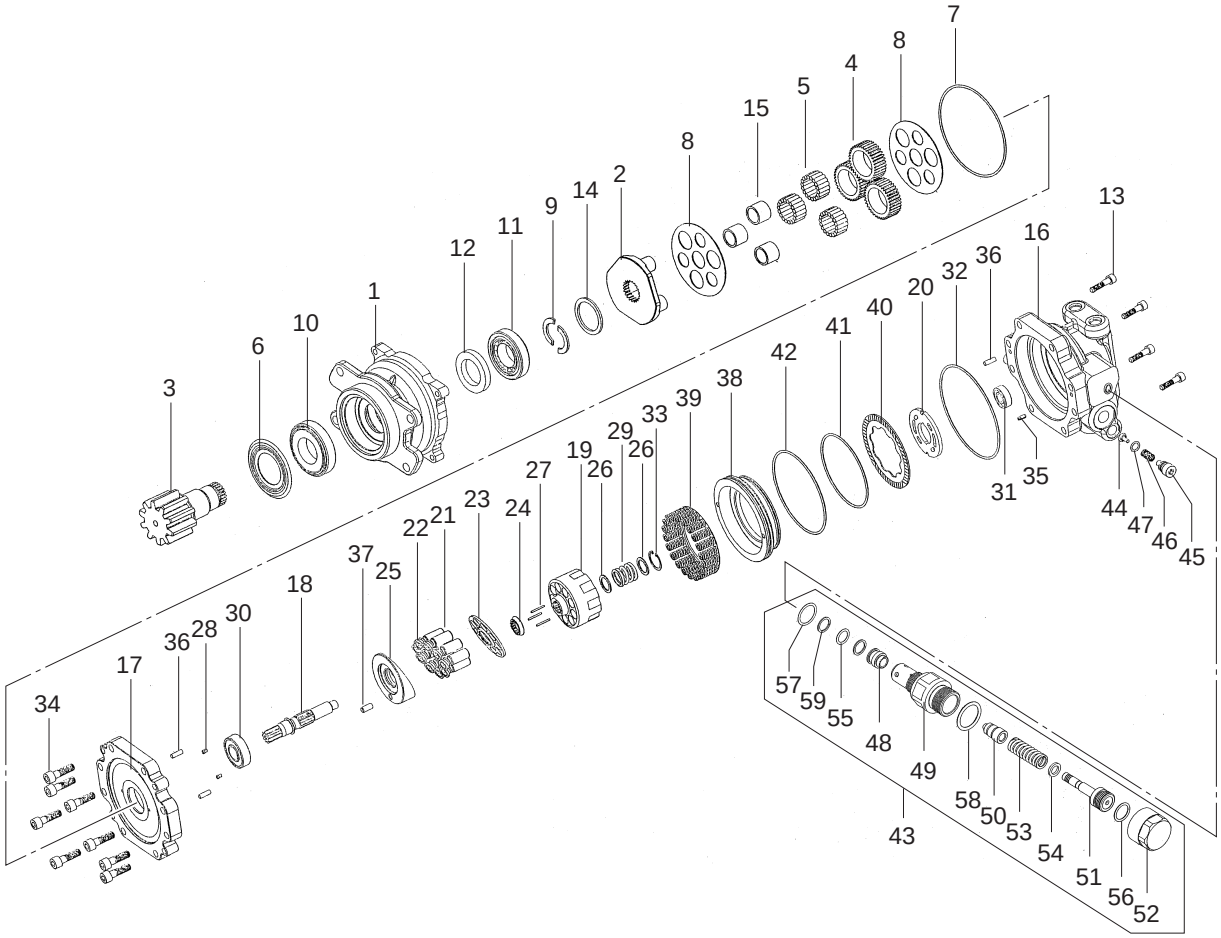
Port	Port size
A	PF 3/8
B	PF 3/8
T	PF 3/8
Dr	PF 3/8

Initial oil replace	500Hr
Second and later replace	1,000Hr



	Type	PCR-1B-05A-P-8446Z1
Reduction	Output torque	423 N·m
	Output speed	70 min^{-1}
	Reduction ratio	1 / 10
Hydraulic motor	Capacity	23.6 cm^3 / rev
	Maximum speed	702 min^{-1}
	Flow rate	17.08 ℓ / min
	Overload relief set pressure	13.2 MPa at 17 ℓ / min
Pinion gear	Module	4
	No. of threads Z	13
Weight		23 kg

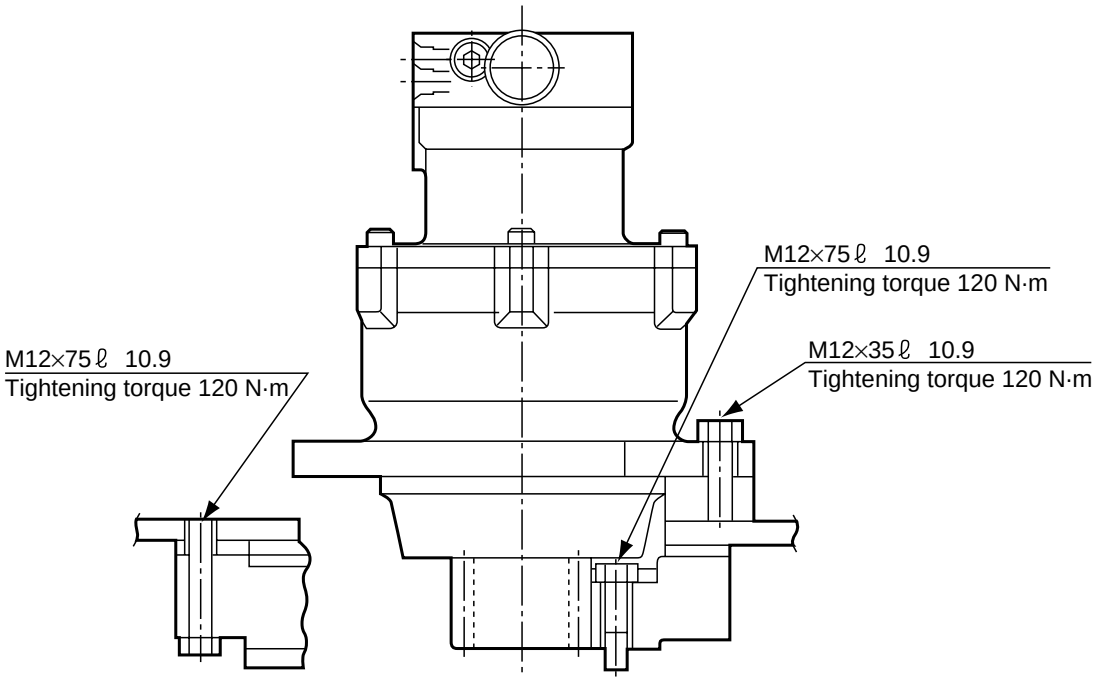
12-2 Structure



1. Body
2. Carrier 1
3. Pinion shaft
4. B1 gear
5. Needle
6. Ring seal
7. O-ring
8. Thrust plate
9. Pre-load collar
10. Bearing
11. Bearing
12. Oil seal
13. Screw
14. Ring
15. Ring
16. Body H
17. Plate S
18. Shaft
19. Cylinder barrel
20. Valve plate
21. Piston
22. Shoe
23. Shoe holder
24. Barrel holder
25. Swash plate
26. Retainer
27. Pin
28. Filter
29. Spring C
30. Bearing
31. Bearing
32. O-ring
33. Snap ring
34. Screw
35. Spring pin
36. Pin
37. Pin
38. Brake piston
39. Spring Ass'y
40. Disk plate
41. O-ring
42. O-ring
43. Relief valve
44. Check valve
45. Plug
46. Spring
47. O-ring
48. Seat
49. Retainer
50. Poppet
51. Piston
52. Cap
53. Spring
54. Spacer
55. O-ring
56. O-ring
57. O-ring
58. O-ring
59. Back up ring

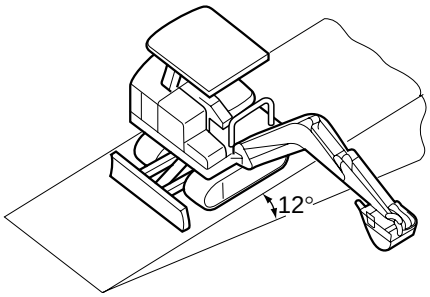
12-3 Standard of maintenance

12-3-1 Slew bearing and slew case



12-4 Inspection and adjustment

12-4-1 Measuring the natural slew distance



1. Position of the machine

   Maintain the hydraulic oil temperature at 50±5°C. Make a slope or use a sleeper to incline the machine by 12°. Set the attachment diagonally, put a weight (W) in the bucket (filling the bucket with soil), retract the arm cylinder to the minimum length, make the boom parallel to the slope and stop engine.

2. Measurement

   Put a mark on the slew bearing outer race and the truck frame and measure the flow rate (deviation rate) of 3 minutes. (Moving distance of slew bearing outer race)Valid gear length

Unit mm or less

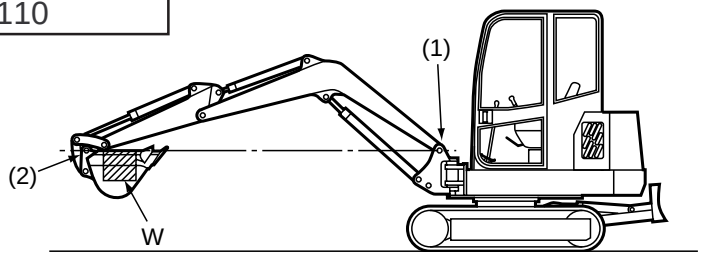
Standard value	Allowance	Weight (W) kg
30(1.2”)	60(2.4”)	110

12-4-2 Measuring the over slew distance after stopping

Maintain the oil temperature at 50±5°C while the engine is running at full speed. Stretch the arm to the maximum length on a flat place. Make the boom joint pin (1) and arm bucket pin (2) put on a horizontal line, put a weight(W) in the bucket (filling the bucket with soil), slew the Machine by one turn and measure the over slew length (at bucket edge) after stopping.

Unit : deg

Standard value	Weight W (kg)
45	110



12-4-3 Measuring the required time for slewing

Extend the bucket cylinder to maximum length, empty the bucket and measure the required time for slewing 5 turns following the first turn.

Unit : sec

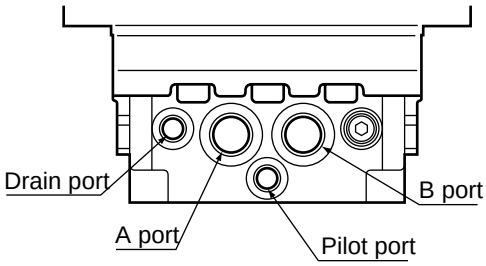
Standard value	Allowance
29±4	42

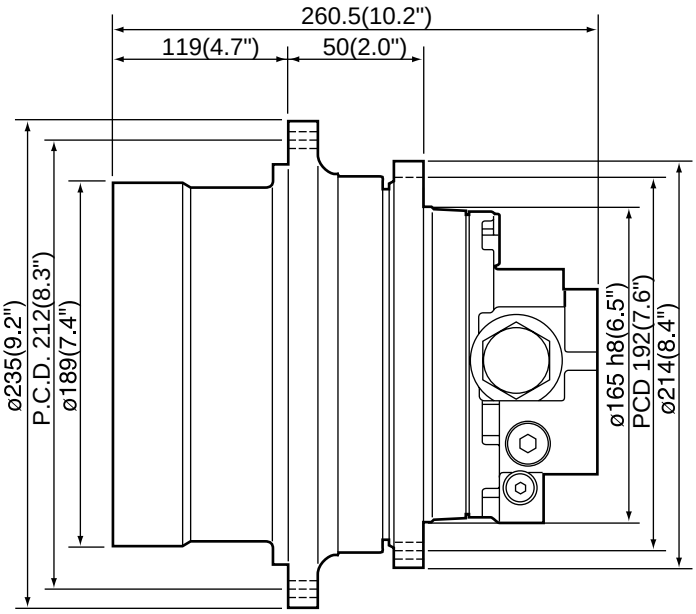
13 TRAVEL MOTOR

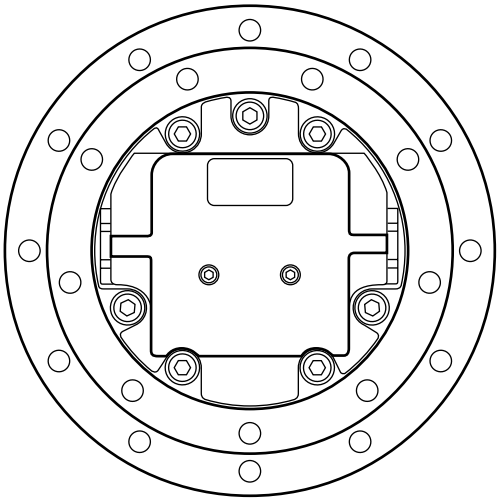
CONTENTS

13-1 Specification
13-2 Structure
13-3 Handling the travel motor
13-4 Measuring travel motor idling and travelling time
13-5 Inspection and adjustment

13-1 Specification

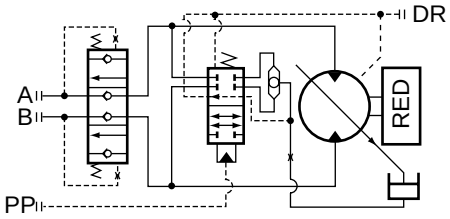






Direction of rotation (viewing from output axis)

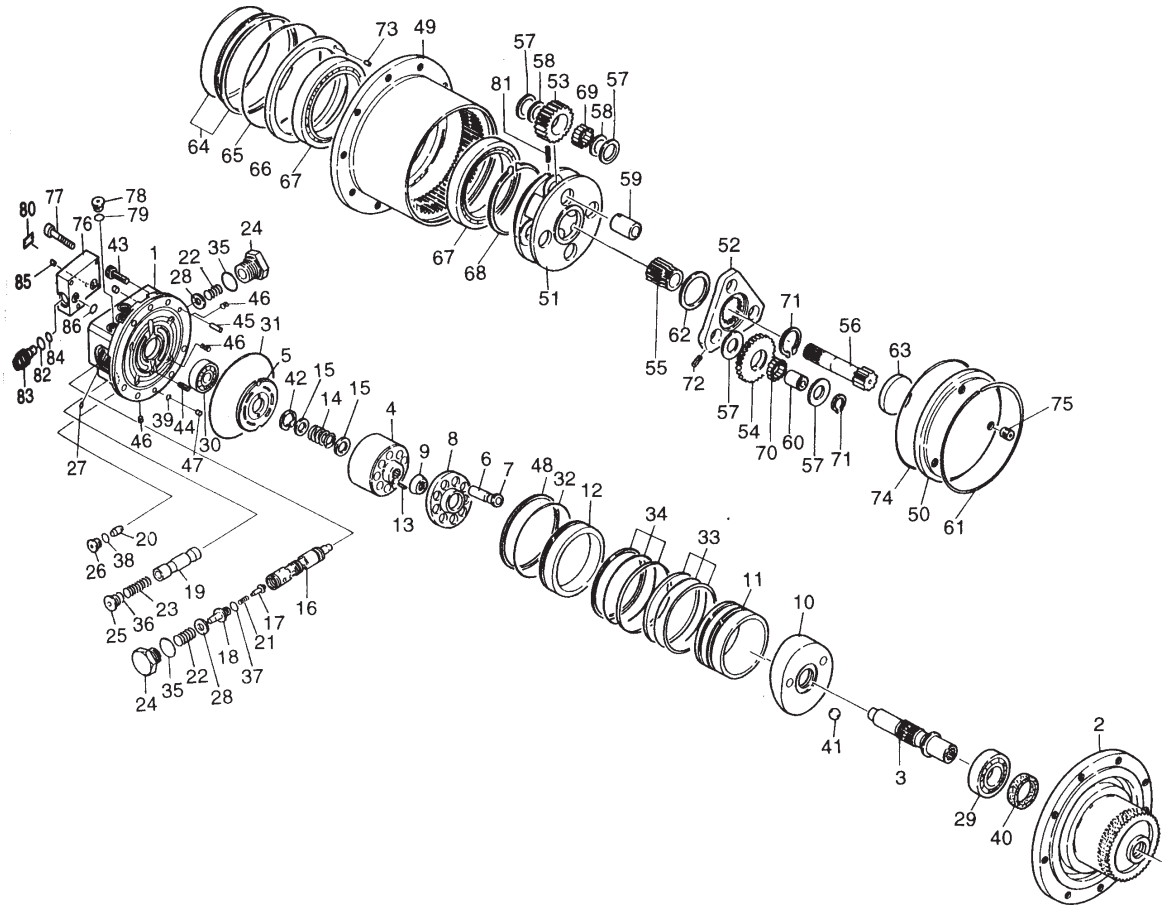
Direction of rotation	Oil pouring port	Oil discharging port
Clockwise	B	A
Counterclockwise	A	B



Port	Port size
A,B	PF1/2
Pilot	PF1/4
Dr	PF1/4

	Item			Item	
Reduction gear	Output torque N·m	240	Others	Equivalent capacity cc / rev	861.6 / 573.2
	Output speed (min^{-1})	25.3/37.7		Oil	ISO-VG46
	Reduction ratio	1/36.5		Oil temperature(°C)	-20~100
Hydraulic motor	Capacity cc / rev	23.6 / 15.7		Filtering (μM)	10
	Working pressure MPa	20.6		Lubricating oil	SAE-30-CD
	Output speed of hydraulic motor (min^{-1})	926 / 1,378			600cc
				Weight kg	36
	Flow rate ℓ/min	22.3			

13-2 Structure

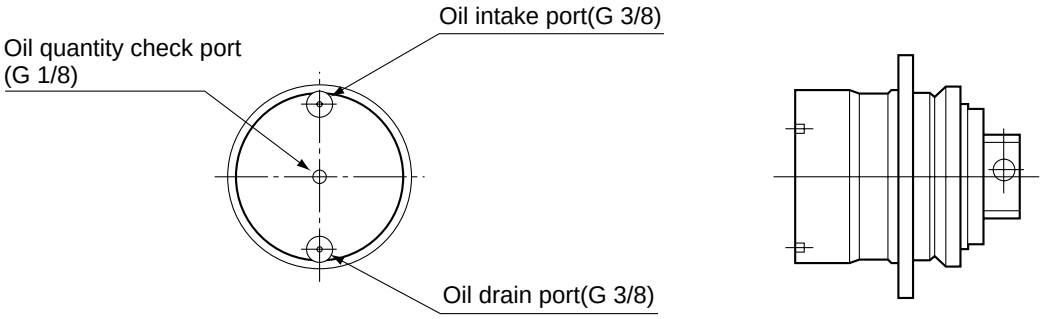


1. Body-1
2. Body-2
3. Shaft
4. Cylinder barrel
5. Valve plate
6. Piston
7. Shoe
8. Shoe holder
9. Barrel holder
10. Swash plate
11. Control cylinder
12. Stopper ring
13. Pin
14. Spring C
15. Retainer
16. Spur
17. Check valve
18. Spring guide
19. Sloop
20. Shuttle spool
21. Spling V1
22. Spring V2
23. Spring V3
24. Plug
25. Plug
26. Plug
27. Choke
28. Ring
29. Bearing (6204)
30. Bearing (6201)
31. O-ring (IB-G125)
32. O-ring (IB-G100)
33. Piston seal
34. Piston seal
35. O-ring (IB-P25)
36. O-ring (IB-P14)
37. O-ring (IA-P12.5)
38. O-ring (IB-P8)
39. O-ring (IB-P7)
40. Oil seal
41. Ball
42. Snap ring (H-28)
43. Screw (M10×25)
44. Spring pin (5×12AW)
45. Pin (h7 A8×15)
46. Plug
47. Choke
48. Backup ring
49. Body
50. Cover
51. Carrier I
52. Carrier II
53. B1 gear
54. B2 gear
55. S1 gear
56. S2 gear
57. B1 pin
58. B2 pin
59. Seal ring
60. Snap ring
61. Thrust collar
62. Floating seat
63. O-ring
64. Bearing
65. Needle
66. Needle
67. Thrust washer
68. Snap ring
69. Snap ring (S-35)
70. Snap ring (S-25)
71. Snap ring (S-13)
72. Spring pin (4×20AW)
73. O-ring
74. O-ring
75. Plug
76. Thrust washer
77. Snap ring (S-30)
78. Screw (M8×40)
79. Plug
80. O-ring (IB-P11)
81. Name plate
82. Pin (h7 B4×6)
83. Thrust washer

13-3 Handling the travel motor

Add lubricating oil according to the following procedure.

1. The cover has three plugs. Turn the motor so the plugs are at right angle to the floor. Use them as the oil intake port, oil quantity check and oil drain ports, starting from the top in that order.



2. First, remove the plugs from the oil intake and oil quantity check port with an Allen wrench.
3. Add lubricating oil through the oil intake until the oil comes out of the intake port.
4. Plug the oil intake and oil quantity check port, then wind seal tape around the plug before tightening.

Amount of lubricating oil	600cc

Schedule for replacing lubricating oil:

First: After the first 200 service hours or 2 months
Second and later times : Every 1,000 service hours or 1 year

Standard maintenance

Tightening torque

Sprocket tightening torque	110 N·m
Motor tightening torque	110 N·m

13-4 Measuring travel motor idling and travelling time

1. Idle crawler for ten turns and measure the required time.

Unit : sec

Standard value	
Low	17±0.8
High	9.6±0.8

(Engine running at full speed and oil temperature of 50±5°C)

2. After travelling 3m on ground level, measure the required time to travel 20m.

Standard value	
Low	25.5±2
High	18±2

(Engine running at full speed and oil temperature of 50±5°C)

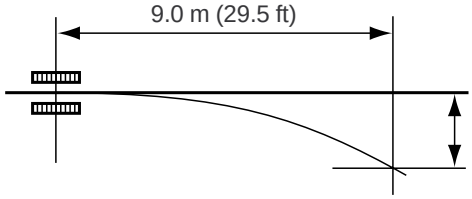
13-5 Inspection and adjustment

1. Measuring meander distance in travelling
   Measure the meandering distance by travelling on hard ground.

Unit : mm or less

Standard value	Max.
200(7.9”)	500(19.7”)

(Engine running at full speed and oil temperature of 50 ± 5˚C)

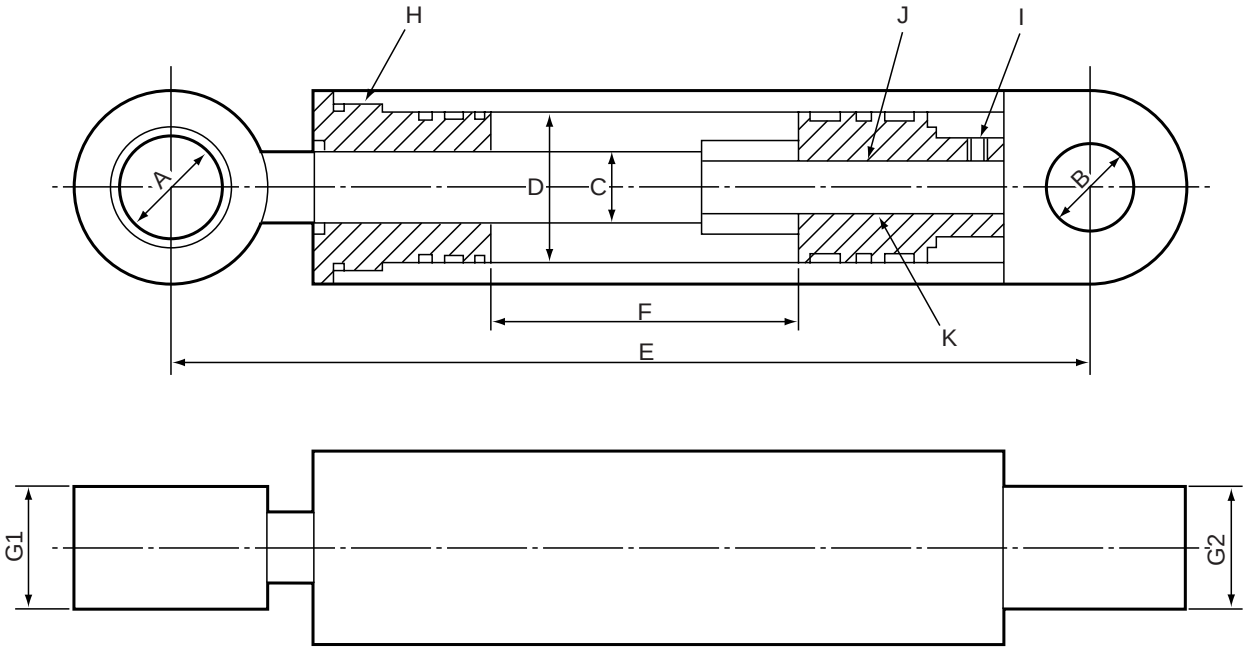


14 HYDRAULIC CYLINDER

CONTENTS

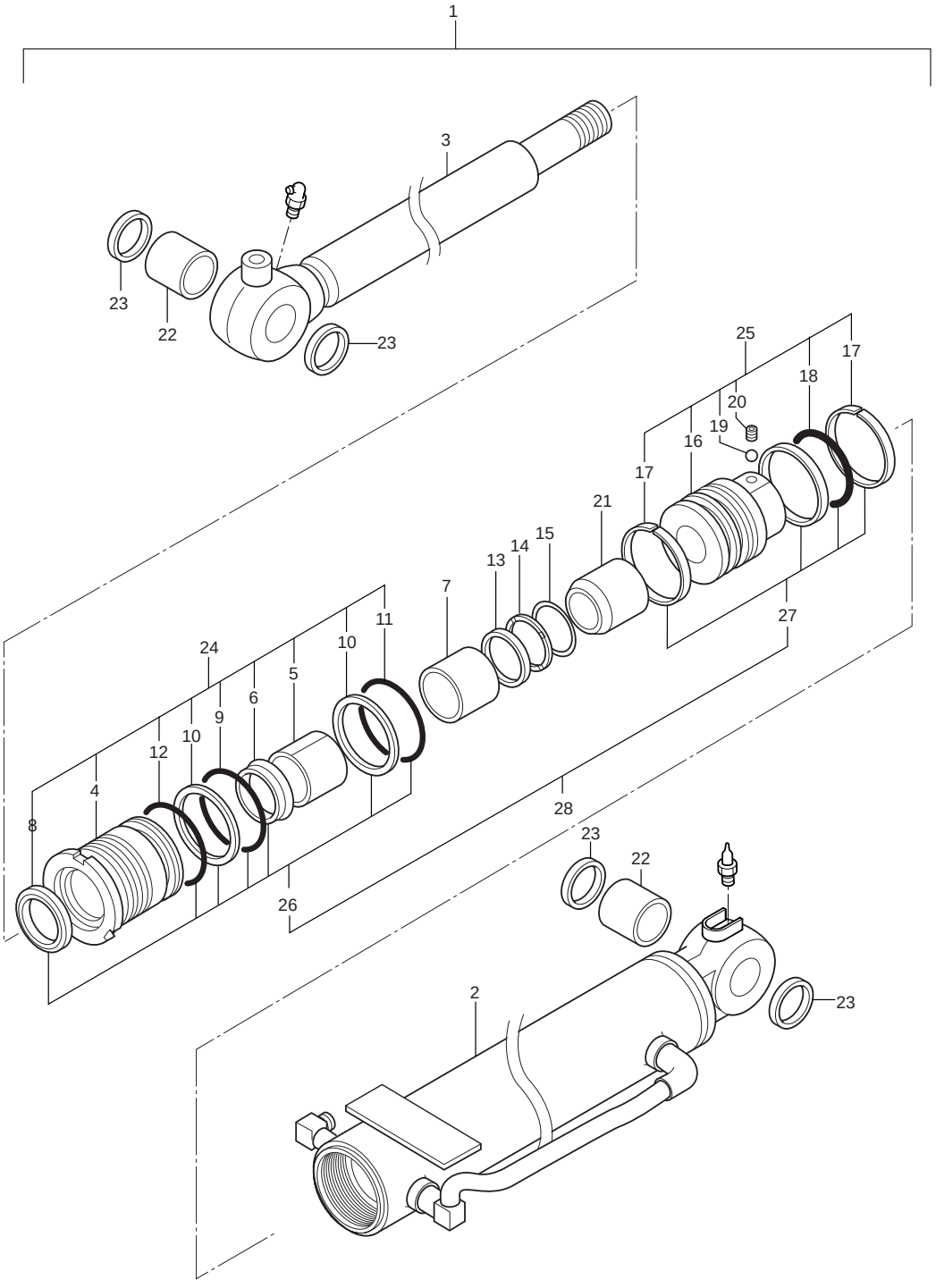
14-1 Structure
14-2 Disassembly and assembly
  14-2-1 Disassembly procedure
  14-2-2 Procedure for disassembling inner parts
14-3 Assembly
  14-3-1 Assembly procedure
  14-3-2 Inspection procedure
  14-3-3 Precautions for assembly

14-1 Structure



Item \ Cylinder			Boom	Arm	Bucket	Swing	Dozer
Weight kg			28	28	23	22	18
Trust force*	Pushing	ton	9.2	9.2	8.0	6.9	9.2
	Pulling	ton	6.6	6.6	4.7	4.3	6.6
A	Pin diameter (rod)	mm	ø40 (1.6”)	ø35 (1.4”)	ø35 (1.4”)	ø35 (1.4”)	ø35 (1.4”)
B	Pin diameter (head)	mm	ø40 (1.6”)	ø35 (1.4”)	ø35 (1.4)	ø35 (1.4”)	ø35 (1.4”)
C	Rod diameter	mm	ø40 (1.6”)	ø40 (1.6”)	ø45 (1.8”)	ø40 (1.6”)	ø40 (1.6”)
D	Cylinder bore	mm	ø75 (2.9”)	ø75 (2.9”)	ø70 (2.7”)	ø65 (2.6”)	ø75 (2.9”)
E	Maximum extended length	mm	1432 (56.4”)	1315 (52.4”)	1105 (43.5”)	1551 (61.1”)	595 (23.4”)
	Maximum contracted length	mm	868 (34.2”)	805 (31.7”)	686 (27.0”)	924.5 (36.4”)	470 (18.5”)
F	Stroke	mm	564 (22.2”)	510 (20.1”)	419 (16.5”)	626.5 (24.7”)	125 (4.9”)
G1	Clevis width	mm	50 (2.0”)	50 (2.0”)	50 (2.0”)	50 (2.0”)	50 (2.0”)
G2			50 (2.0”)	50 (2.0”)	50 (2.0”)	50 (2.0”)	50 (2.0”)
H	Tightening torque	N·m	430	430	390	350	430
I	Tightening torque	N·m	10	10	10	10	10
J	Tightening torque	N·m	700	700	680	530	700
K	Size of piston screw (size × pitch)		M27 × 1.5	M27 × 1.5	M30 × 1.5	M27 × 1.5	M27 × 1.5
*Main relief pressure		MPa	20.6	20.6	20.6	20.6	17.2

14-2 Disassembly and assembly

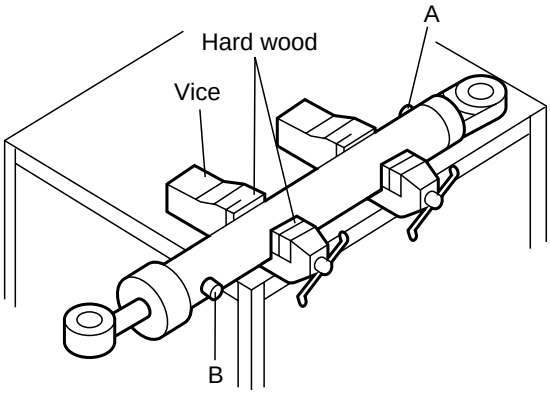


The illustration shows a boom cylinder.

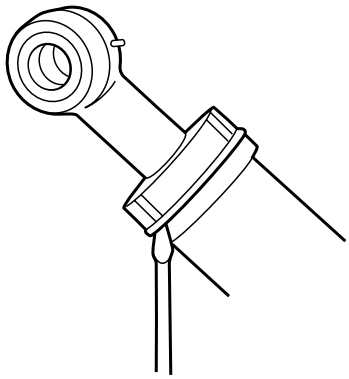
1. Cylinder assembly
2. Tube
3. Rod
4. Rod cover
5. Rod bush
6. U-ring
7. Retainer
8. Wiper ring
9. O-ring
10. Backup ring
11. O-ring
12. O-ring
13. Cushion ring
14. Spacer
15. Stopper
16. Piston
17. Slide ring
18. Seal ring assembly
19. Steel ball
20. Set screw
21. Cushion bearing
22. Pin bush
23. Dust seal
24. Cylinder head assembly
25. Piston assembly
26. Rod packing assembly
27. Piston packing assembly
28. Packing assembly

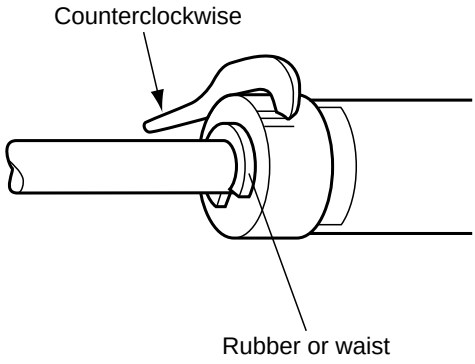
14-2-1 Disassembly procedure

1. Hold the cylinder with the vice.
   Tighten the vice carefully; do not deform the cylinder. Blow air alternately from ports A and B and operate the piston rod to drain oil from the cylinder inside. To remove the piston, pull the piston rod about a third of the length.

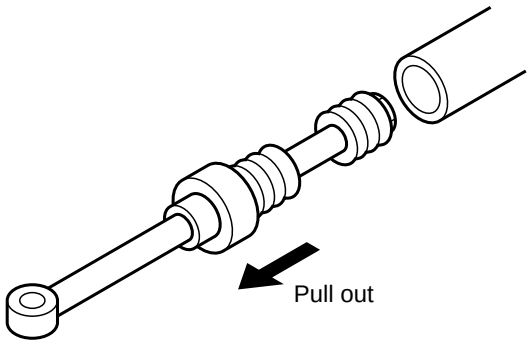


2. Loosen and remove the rod cover from the cylinder tube assembly with a hook wrench.



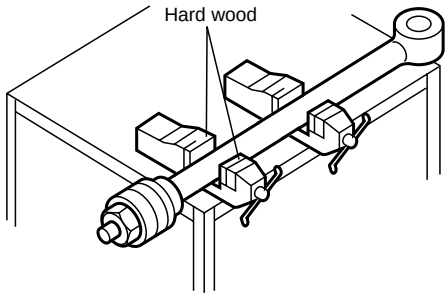


3. Disassembling the piston rod assembly
   Slowly turn the piston rod assembly to remove it from the cylinder tube assembly. Place the removed piston rod assembly on a wooden bench or a waste to prevent damage.



4. Disassembling the piston assembly
Hold the piston rod assembly with a vice.

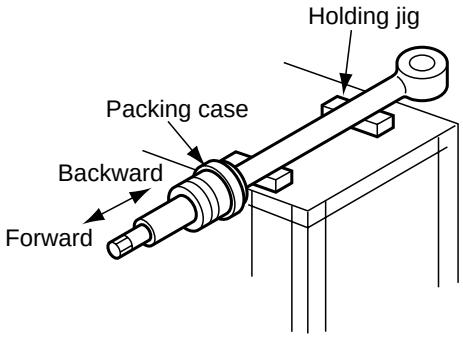
- Put the waste between hard wood and the piston to prevent the surface sliding from being damaged.
- Set the piston rod assembly on a level block so that it becomes parallel to the level block. Be careful because the piston rod assembly may come out of the vice and be damaged if it is set diagonally.



14-2-2 Procedure for disassembling inner parts

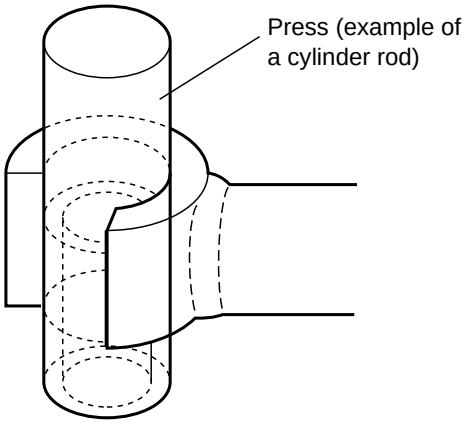
1. Remove the piston assembly from the piston rod assembly (after removing the set bolts). Then remove the cushion bearing in the direction of the arrow.

2. Disassembling rod cover
Put piston rod assembly on a holding jig on the work bench.
Make a working face for the rod cover assembly on the workbench and move the rod cover to and fro to remove it.
Remove the backup ring then the O ring with a screwdriver. If they are to be reused, be careful not to damage them.



3. Disassembling the packing assembly
Remove the packing by prying it with an eyeleteer or a screwdriver. Be careful not to damage the groove of the cover and piston. Because it is difficult to remove the dust seal and rod packing without damaging them, remove them by inserting a eyeleteer or a similar tool and prying them out. Be careful not to damage the groove on the cover and piston.

4. Disassembling the piston rod and cylinder tube assembly
As the bushes are pressed fit to the rod head, press them out with a pressing machine to remove them. For a spherical bearing, the snap ring must be removed first.



14-3 Assembly

14-3-1 Assembly procedure

1. The assembly procedure is the reverse of disassembly.
2. Before assembly, check whether metallic powder or other foreign matter is not sticking to any of the parts and whether the parts can be reused.
3. Coat hydraulic oil on each part before assembling them.
4. Assemble beforehand the parts into the following assemblies.

   • Cylinder tube assembly
   • Rod cover assembly
   • Piston rod
   • Piston assembly

14-3-2 Inspection procedure

Clean each disassembled part with light oil or treated oil except for the packings.
Packings are cleaned with petroleum hydraulic oil.
Other types of oil will remarkably shorten the life of the packing.
Thoroughly clean the sliding surface, oil hole, O ring, packing groove, etc. If the part is not used for a long time after being cleaned, execute a rust proof treatment.
(Coating hydraulic oil is effective for rust prevention to a certain degree.)

1. Check all parts for flaws, cracks, deformation, rust, or burrs which may affect the operation. (Inside of the tube, rod, etc.)
2. Check each part for metallic powder or other foreign matter sticking to it.
3. Check the sliding surface of piston rod for damage, uneven abrasion, discoloring, or any defect which may affect its operation.
4. Packings and seals are usually replaced with new one. If you must reuse them, check that there are no tears, cuts or foreign matter sticking to the packing.

14-3-3 Precautions for assembly

Assemble the cylinder while paying attention to the following matters.

1. Replace the packings with new ones before assembly.
2. Execute assembly work paying attention to the direction of cushion bearings (boom, arm, bucket and swing) and seal rings (arm and swing).
3. Replace the set bolts with new ones.
   In assembling, after tightening the set bolts, further tighten and firmly fix them by hitting with punch at two points on the periphery.
4. Tighten the rod cover, piston and nuts with a specified tightening torque shown in the attached table (page 14-1).
5. Check fully before starting assembly work.

15 SWIVEL JOINT

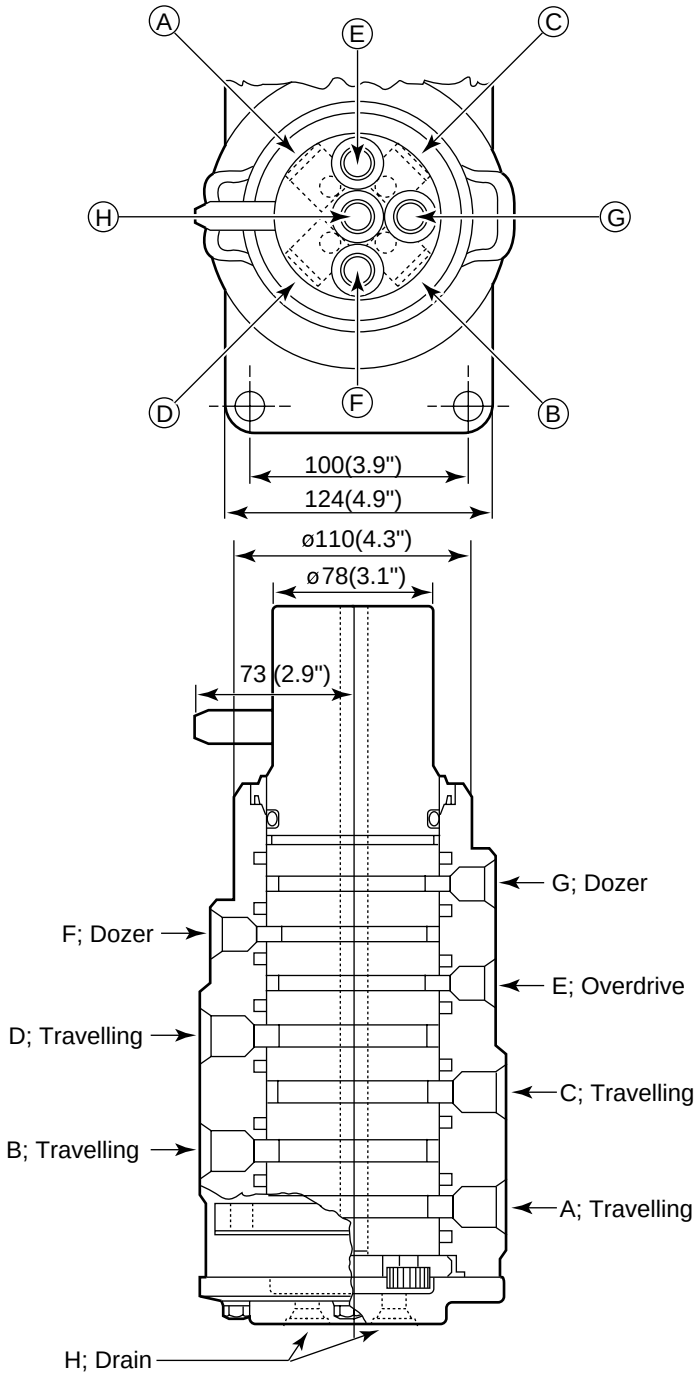
CONTENTS

15-1 Specification and Structure
15-2 Structure, disassembly and assembly

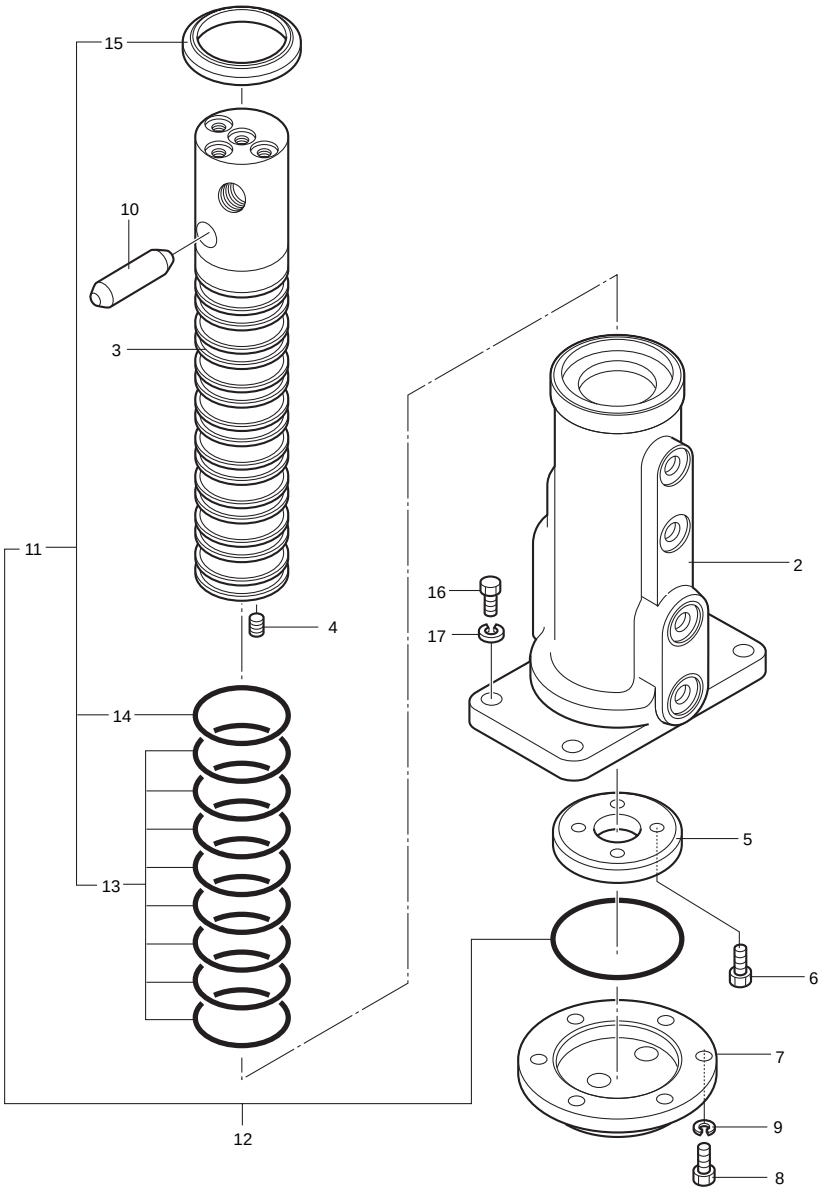
15-1 Specification and Structure

Working pressure	H	0.5 MPa
	E	0.98 MPa
	A~D, F, G	20.5 MPa
Port size	E~H	PF 1/4
	A~D	PF 3/8
Working speed		10 min^{-1}

*A to H and D rain denote the position of the port.



15-2 Structure,disassembly and assembly



1. Swivel joint assembly
2. Cylinder
3. Roter
4. Plug
5. Thrust washer
6. Socket head bolt
7. Cap
8. Bolt
9. Spring washer
10. Knock pin
11. Packing assembly
12. O-ring
13. Slipper seal
14. O-ring
15. Dust seal

Disassembly:

1. Remove bolt (8) and cap(7).
2. Remove the bolts (6) and thrust washer (5).
3. Remove the shaft (3) from the hub (2) upward. Because the shaft is tightened by the tension of the O ring, tap a hammer on the shaft by rotating it and pull it up.
   * Be careful so that O ring does not become trapped.

Assembly:

1. Before assembly, check the O ring and sliding part for flaws and other defects.
2. Assembly is usually executed in the opposite order of disassembly.
   Coat a little hydraulic oil or grease on the O rings before assembly.

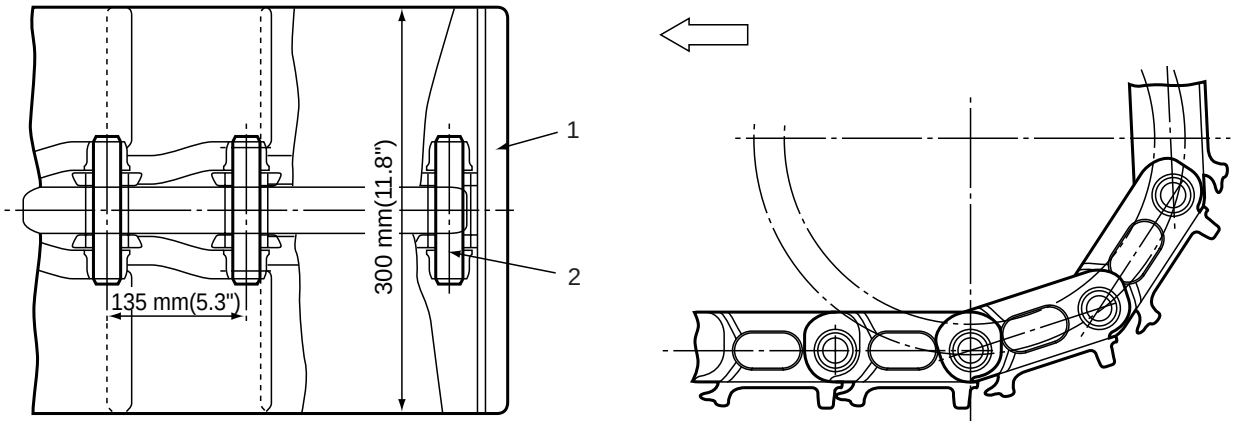
16 CRAWLER

CONTENTS

16-1 Structure and operation
16-1-1 Crawler (Steel)
16-1-2 Track frame
16-2 Standard of maintenance
16-2-1 Crawler (Steel)
16-3 Disassembly and assembly
16-3-1 Installing the crawler
16-3-2 Removing the crawler
16-3-3 Track frame spring
16-3-4 Life of the rubber crawler
16-3-5 Handling the rubber crawler

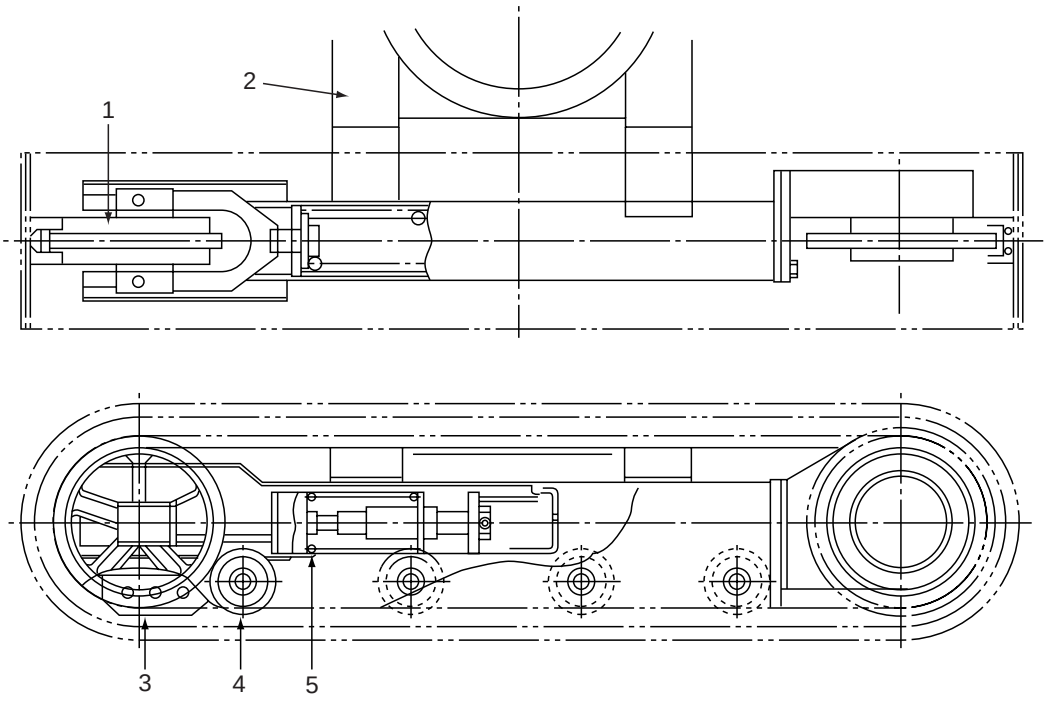
16-1 Structure and operation

16-1-1 Crawler (steel)



1. Shoe
2. Pin

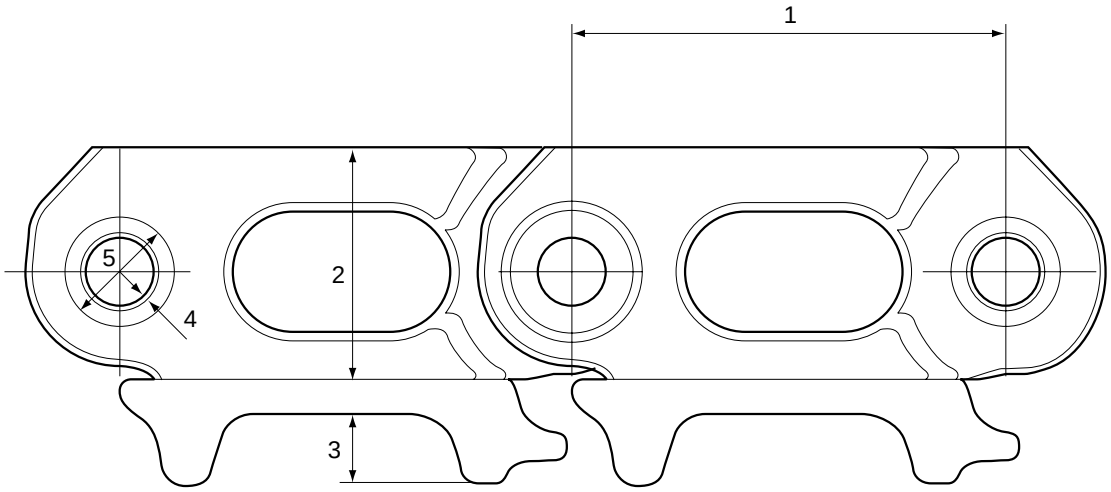
16-1-2 Track frame



1. Idler
2. Track frame
3. Guard (for steel crawler)
4. Track roller
5. Spring

16-2 Standard of maintenance

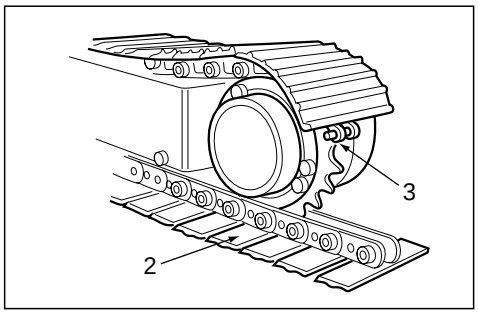
16-2-1 Crawler (steel)



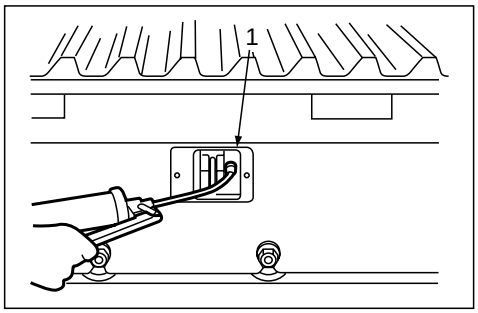
No.	Item	Unit	Standard value	Allowance	Remarks
1	Link pitch	mm	101.6(4.0”)	104(4.1")	Measure by stretching 5 links except for the master link
2	Link height		61(2.4")	58.5(2.3")	Pad or replace
3	Grouser height		16.5±1.5(0.6”±0.06”)	7(0.3")	Pad or replace
4	Pin clearance		0.33(0.012”)	2(0.08")	Replace
5	Bush outer diameter		32.2(1.26")	29(1.14")	Replace

16-3 Disassembly and assembly

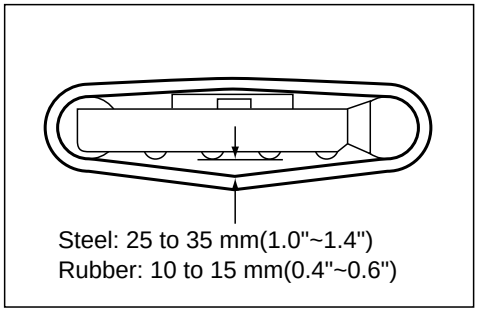
16-3-1 Installing the crawler



1. Crawler
   After the sprocket put on the crawler (2), drive motor to bring it above the idler and for steel crawler, fix the master pin (3) into the hole. For a rubber crawler, the crawler by using the idler as it is. Install steel bar and heavy duty hammer into the undercarriage.

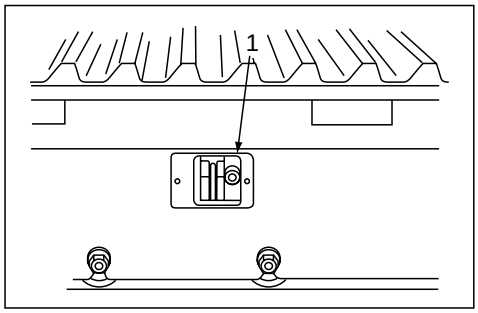


2. Tension the crawler
   Tighten the cartridge valve (1) of the adjust cylinder, grease and adjust the tension.



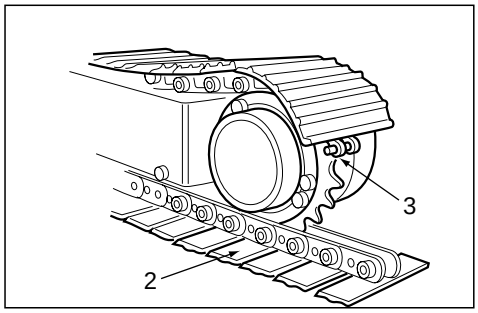
16-3-2 Removing the crawler

1. Loosen the crawler.
   By loosen the cartridge valve (1) of the adjust cylinder, drain grease and loosen the crawler (2).



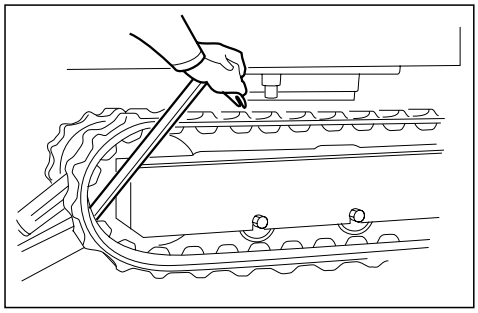
2. Crawler

1) Lift the main frame with attachment and put blocks under to lift the machine.

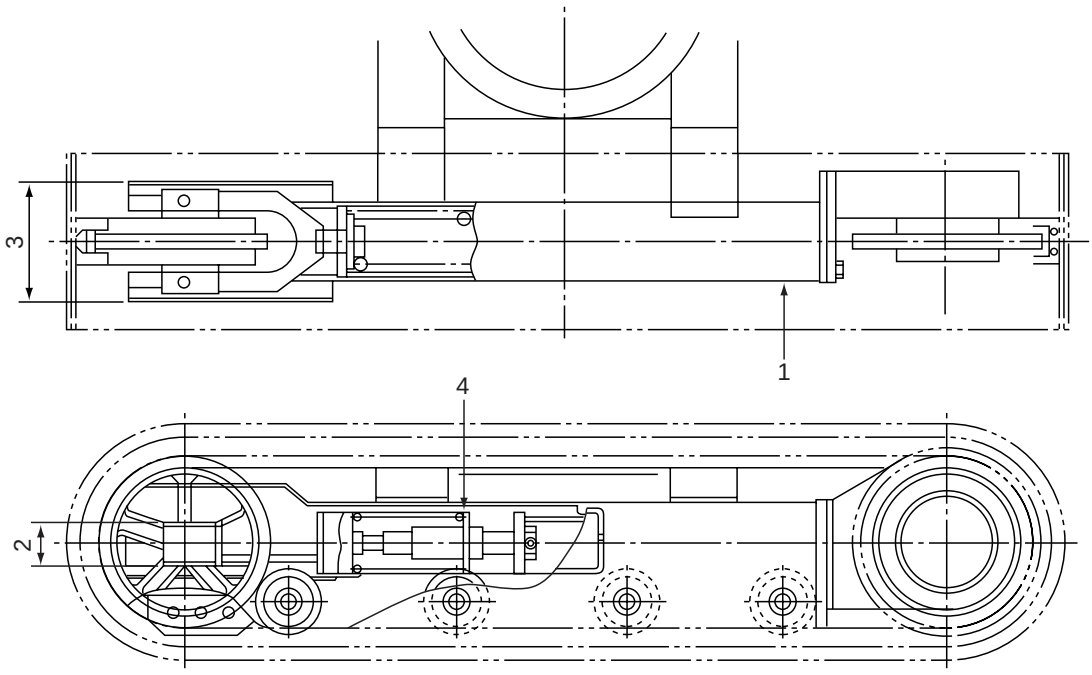


2) Turning in the direction of the idler side, remove crawler master pin (3) and then the crawler (2) from track frame.
   Weight (steel crawler): 312 kg (156×2)

3) As rubber crawler is endless and of solid material, push the idler to the end and remove the rubber crawler by using steel bar from the idler.
   Weight (rubber crawler): 276 kg (138×2)



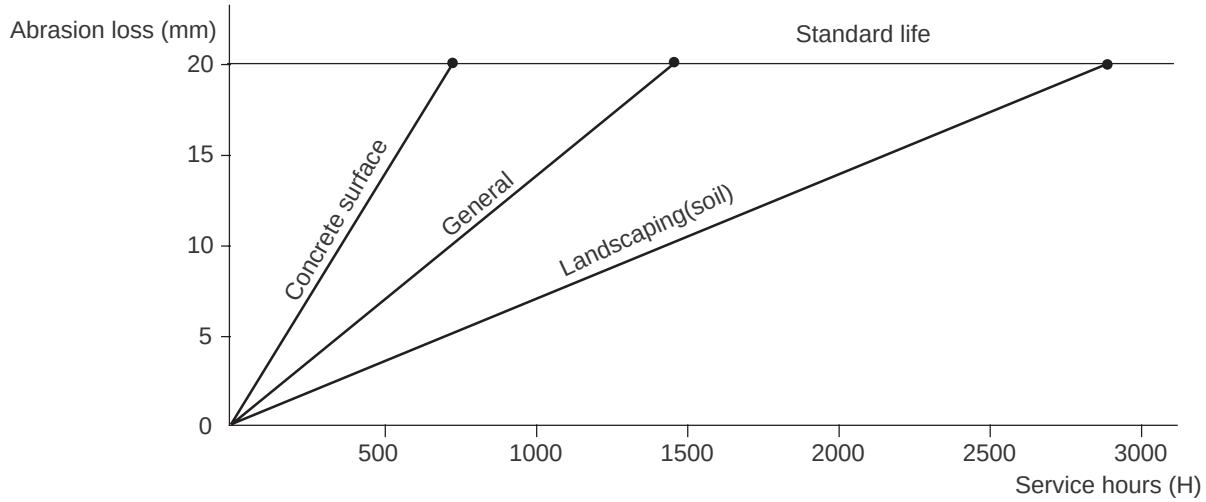
16-3-3 Track frame spring



Unit: mm

No.	Item	Standard			Remedy
1	Deformation of frame		Allowable limit		Correct
		Bend	5 (0.2") (Overall length of track frame)		
		Twist	10 (0.4") (Twist between left and right crawler frames)		
		Opening of idler	5 (0.2")		
2	Distance between upper and lower faces of idler guide		Standard value	Allowable limit	Pad or replace
		2-1 Track frame	$126^{+1.0}_{-0}$ ($5.0"^{+0.04}_{-0}$)	131 (5.2")	
		2-2 Idler frame	$124^{+0}_{-0.5}$ ($4.9"^{+0}_{-0.02}$)	119 (4.7")	
3	Distance between left and right faces of idler guide	3-1 Track frame	$166^{+1.0}_{-2.0}$ ($6.5"^{+0.04}_{-0.08}$)	171 (6.7")	Replace
		3-2 Idler support	162±1.0(6.4"±0.04")	157 (6.2")	
4	Spring (free length)	Standard value	Allowable limit		Replace
		Set length	203.5 (8.0")		

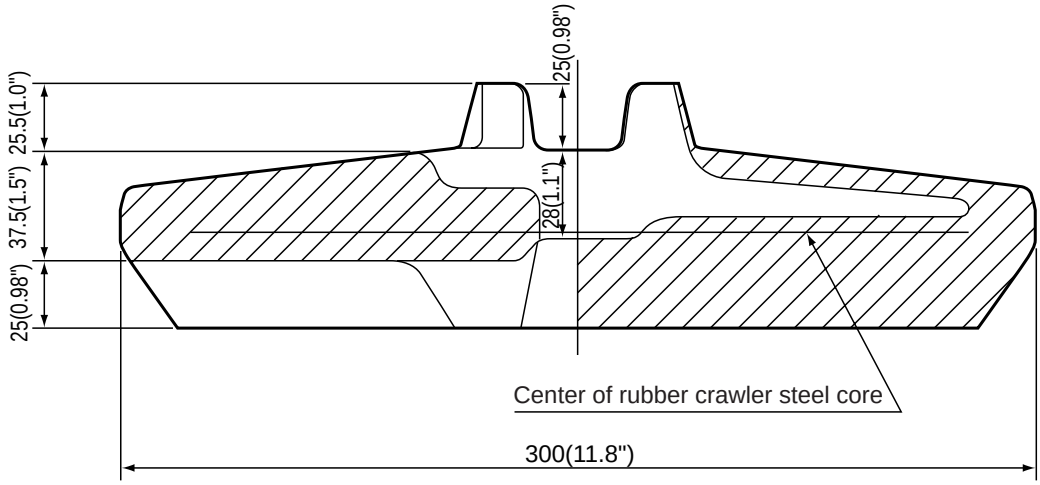
16-3-4 Life of the rubber crawler

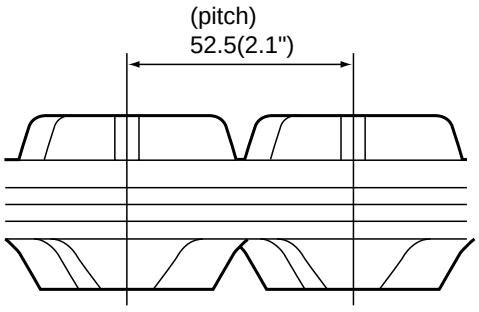


Check the remaining life of the rubber crawler by the abrasion loss in the rubber crawler height as shown in the figure below. Note that the life slightly differs depending on the conditions of site and the operation of the machine.

PRECAUTIONS:

(1) Wipe immediately if fuel or hydraulic oil sticks to rubber crawler.
(2) Check that there are no sharp edges protruding on the ground.
(3) Avoid using on beach. (This may affect the adhesion of the core metal.)
(4) If the machine is going to be stored for a long time, never store it where it will be directly exposed to sunlight.





Description		Value
Total length of rubber crawler		3,960±12(156"±0.5")
Steel cord	Tension	400 kg / piece
Steel cord	No. of cords	60±4
Range of working temperature		-25°C~55°C
Width × pitch		300×52.5

16-3-5 Handling the rubber crawler

1. Do not run over or turn on a sharp edge
   If you run over or turn on a projecting sharp edge or a stepped grade, the machine will partially load on the rubber crawler and split it or cut the threads of the rubber crawler and the inner steel cord.

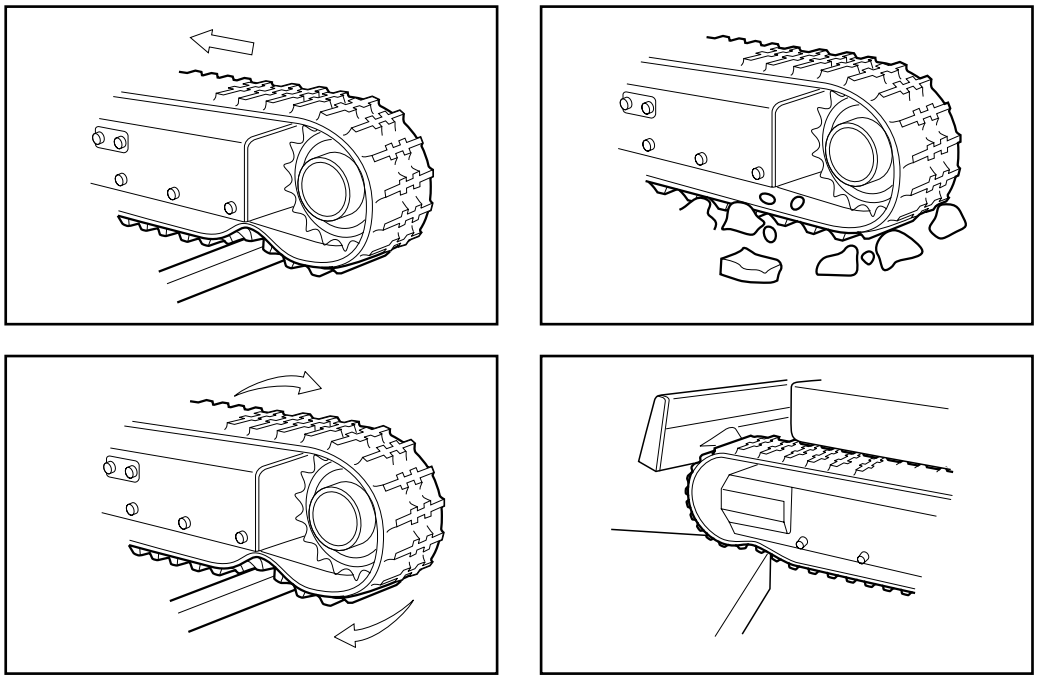
2. Prevent foreign matter from entering the rubber crawler
   Foreign matter will strain the crawler and cut it.

3. No sharp turns
   Do not turn sharply on a road with a high-friction factor (such as a concrete road).

4. Keep oil products away from the rubber crawler
   If you spill fuel or hydraulic fluid on the rubber crawler, clean it promptly.

5. Protect from salt
   Do not operate on beach (Core metal will rust due to salt corrosion).

6. Store indoors
   If the machine is not used for a long time, keep it indoors to prevent exposure to direct sunlight and rain.

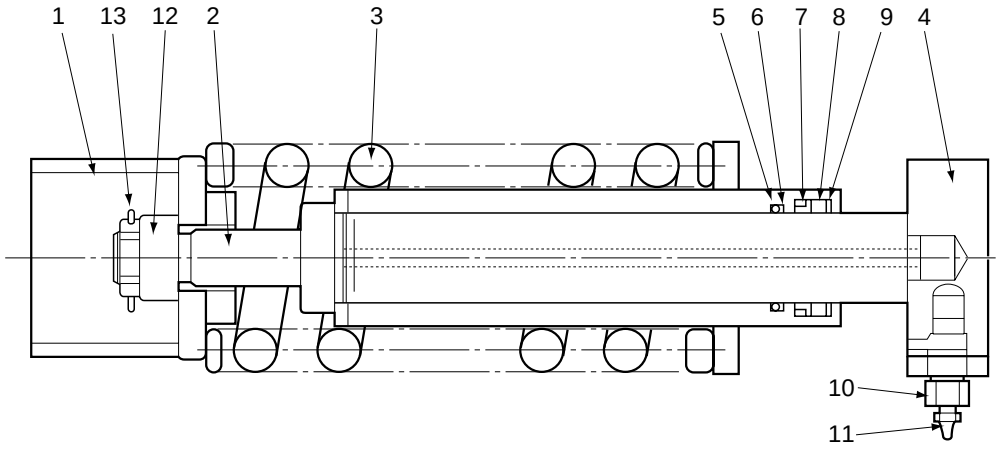


17 SPRING CASE AND GREASE CYLINDER

CONTENTS

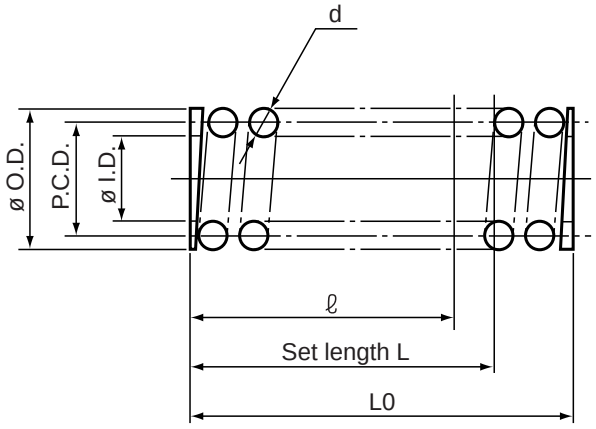
17-1 Structure
17-2 Specification of spring
17-3 Disassembly and assembly
17-3-1 How to disassemble and assemble the ad just cylinder
17-3-2 How to disassemble and assemble the spring case

17-1 Structure



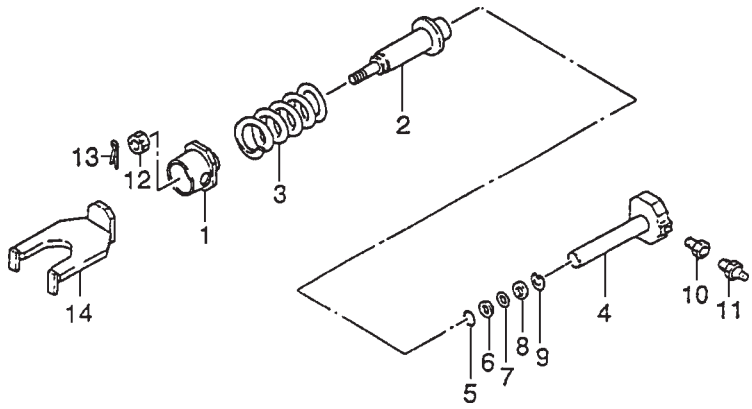
1. Plate
2. Cylinder
3. Spring
4. Rod
5. O-ring (IB-P40)
6. Backup ring (T2-P40)
7. Dust seal (DKR-40)
8. Spacer
9. Snap ring (H-52)
10. Cartridge valve
11. Grease nipple (PT1/8-A)
12. Castle nut
13. Split pin

17-2 Specification of spring



Name	Value	Name	Value
No. of active coils	7.5	ℓ Length at max. shrinkage (mm)	195.1(7.7")
Total number of coils	9	ø O.D. (outer diameter)(mm)	107(4.2")
Spring constant (kgf/mm)	50.9 (2.0")	P.C.D. (Center diameter) (mm)	85(3.3")
Set force (kg)	2,698	øI.D. (Inner diameter) (mm)	63(2.5")
Force at max. shrinkage (kg)	4,650	Wire diameter d (mm)	22(0.9")
Lo Free length (mm)	286.5(11.3")	L set length (mm)	233.5(9.2")

17-3 Disassembly and assembly



1. O-ring (IB-P30)
2. Cylinder
3. Backup ring (T2-P40)
4. Rod
5. Scraper (DSI)
6. Backup ring (T2-P40)
7. Castle nut
8. Spacer
9. Split pin
10. Cartridge valve
11. Spring
12. Castle nut
13. Split pin
14. Idler yoke

Cylinder effective stroke: 150 mm(5.9")

17-3-1 How to disassemble and assemble the adjust cylinder

1. Disassembly

   a. Remove the cartridge valve from the adjust cylinder rod.
   b. Remove the cylinder rod from the adjust cylinder tube.
   c. Remove the snap ring, spacer, dust seal, backup ring and O-ring.

2. Assembly
   The assembly procedure is the reverse of the disassembly procedure.

   a. Attach the O-ring, backup ring and spacer to adjust cylinder tube.
      *Coat grease on the O-ring and dust seal before assembly.
   b. Attach the adjust cylinder rod to adjust the cylinder tube carefully so that the seals are not damaged. Apply grease before hand in the adjust cylinder tube. Attach the cartridge valve to the adjust cylinder rod so that the screw on the second step reaches the tapped hole. When attaching the adjust cylinder rod, tighten the cartridge valve after checking that grease comes out of the grease drain hole.

Note:

- Adjust and assemble carefully so that air does not remain in the adjust cylinder tube.
- Coat grease on the piston of the cylinder tube rod before assembly.
  Tightening torque of the cartridge valve: 187 to 210 N·m

17-3-2 How to disassemble and assemble the spring case

1. Disassembly
   Lower the spring force between the front idler and adjust cylinder tube using a pressing machine and the special purpose tool.

   a. Remove the castle nut for the mounting spring.
   b. Remove the spring from adjust cylinder tube.

Note:
- Be careful when using the tool when removing the spring. Also, be careful during assembly.

2. Assembly
   The assembly procedure is the reverse of disassembly.
   Attach the spring to adjust cylinder tube using the special tool and set the spring to the specified position with the castle nut.
   After adjustment, completely bend the split pin.
   Spring set length: 233.5mm(9.2")

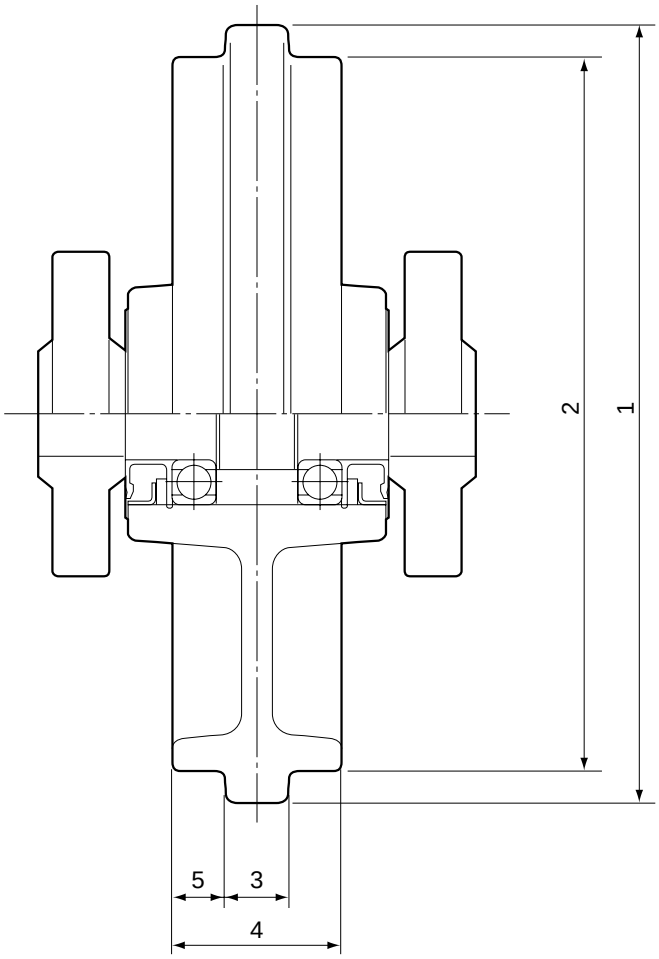
18 IDLER

CONTENTS

18-1 Standard of maintenance
18-1-1 Idler

18-1 Standard of maintenance

18-1-1 Idler



No.	Item	Unit	Standard value	Allowance	Remark
1	Outer diameter of projected part	mm	ø311(12.2”)	ø307(12.1”)	Pad or replace
2	Outer diameter of tread	mm	ø269 (10.6”)	ø265 (10.4”)	Pad or replace
3	Width of projected part	mm	25 (1.0”)	21 (0.8”)	Pad or replace
4	Overall width	mm	65 (2.6”)	60 (2.4”)	Pad or replace
5	Width of tread	mm	20 (0.8”)	24 (0.9”)	Pad or replace
6	Quality of lubricating oil	cc	80		Gear oil or engine oil

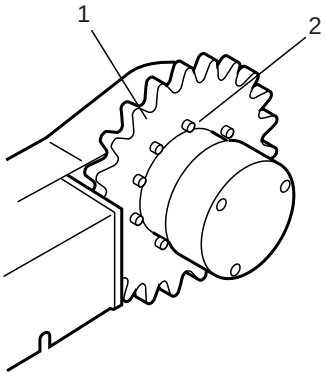
19 SPROCKET

CONTENTS

19-1 Disassembly and assembly
19-1-1 Removing the sprocket
19-1-2 Installing the sprocket
19-2 Standard of maintenance
19-2-1 Sprocket

19-1 Disassembly and assembly

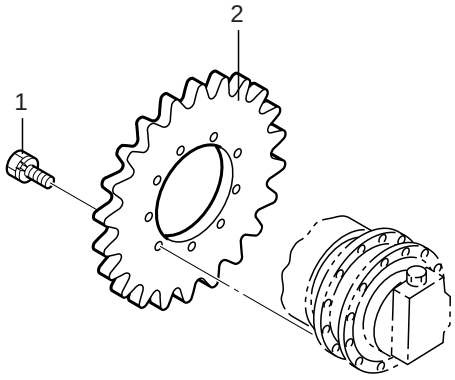
19-1-1 Removing the sprocket



1. Crawler
   Refer to the explanation on crawler removal.

2. Sprocket
   Remove sprocket mounting bolts (1) and then sprocket (2) from the travelling motor assembly.

19-1-2 Installing the sprocket

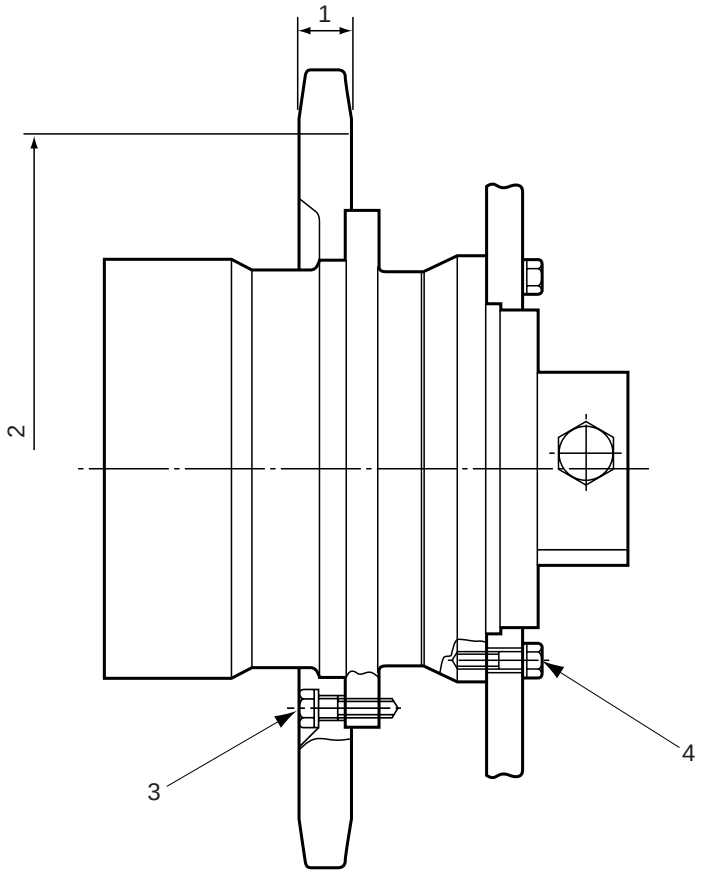


1. Sprocket
   Attach the sprocket to travelling motor assembly and tighten the mounting bolts (1).
   Tightening torque:100 N·m~110 N·m (72.3~80 lb-ft)

2. Crawler
   Refer to the explanation of crawler installation.

19-2 Standard of maintenance

19-2-1 Sprocket



No.	Item	Unit	Standard value	Allowance	Remarks
1	Width of sprocket teeth	mm	25(1.0")	19(0.07")	Pad or replace
2	Minor diameter of sprocket	mm	ø313.8(12.4")	ø305.8(12.0")	Pad or replace
3	Tightening torque of sprocket mounting bolt	N·m	100~110	—	Tighten some more. (M10 P1.5)
4	Tightening torque of motor mounting bolt	N·m	100~110	—	Tighten some more. (M10 P1.5)

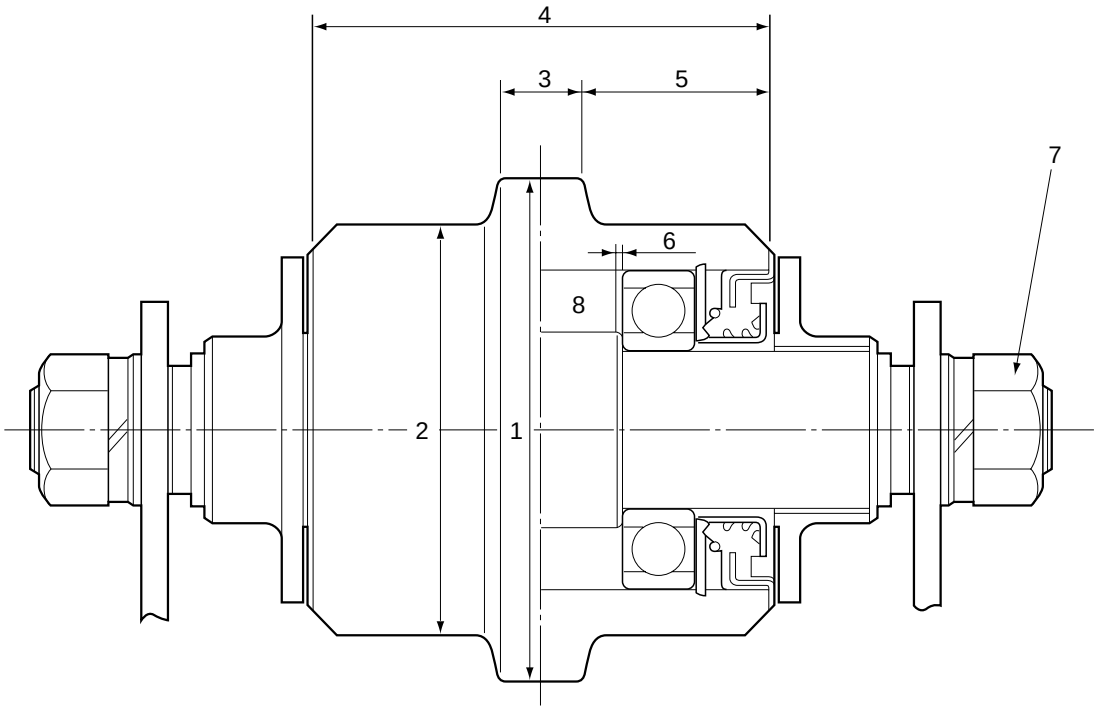
20 TRACK ROLLER

CONTENTS

20-1 Standard of maintenance
20-1-1 Track roller

20-1 Standard of maintenance

20-1-1 Track roller



No.	Item	Unit	Standard value	Allowance	Remarks
1	Outer diameter of projected part	mm	ø115(4.5”)	—	Pad or replace
2	Outer diameter of tread	mm	ø95(3.7”)	ø92(3.6”)	Pad or replace
3	Width of projected part	mm	24(0.9")	21(0.8")	Pad or replace
4	Overall width	mm	108(4.3")	—	Pad or replace
5	Width of tread	mm	42(1.7")	—	Pad or replace
6	Roller side clearance	mm	0.2±0.1	1.5(0.06”)	Replace bush
7	Tightening torque for mounting roller	N·m	325		Tighten some more.(M24 P3)
8	Quantity of lubricating oil	cc	100		Gear oil or engine oil

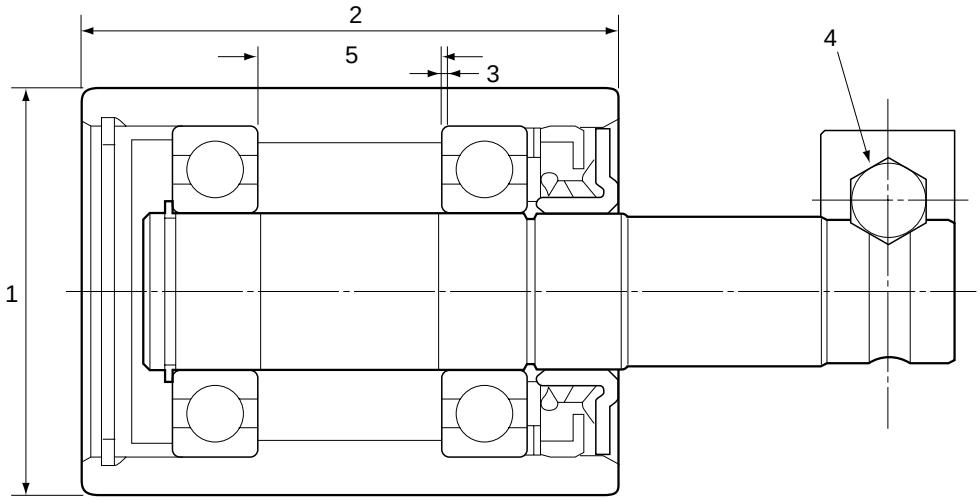
21 CARRIER ROLLER

CONTENTS

21-1 Standard of maintenance
21-1-1 Carrier roller

21-1 Standard of maintenance

21-1-1 Carrier roller



No.	Item	Unit	Standard value	Allowance	Remarks
1	Outer diameter of projected part	mm	ø76 (3.0”)	ø73 (2.9”)	Pad or replace
2	Overall width	mm	100 (3.9”)	—	Pad or replace
3	Roller side clearance	mm	0.2±0.1 (0.008”±0.004”)	1.5 (0.06”)	Replace bush
4	Tightening torque for mounting roller	N·m	22		Tighten some more. (M8 P1.25)
5	Quantity of lubricating oil	cc	70		Gear oil engine oil

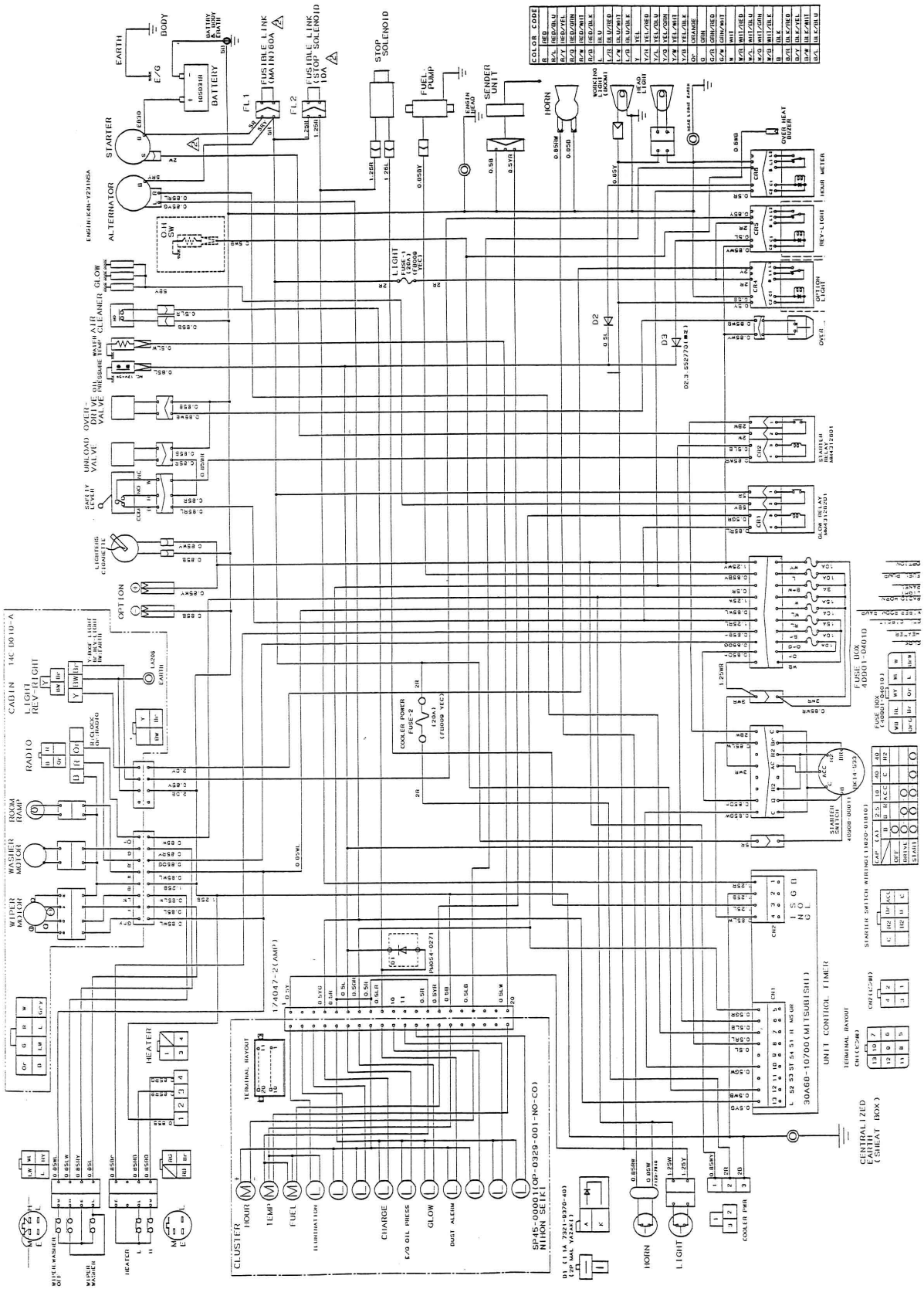
22 ELECTRICAL EQUIPMENT

CONTENTS

22-1 Structure and function
19-1-1 Electric circuit diagram
22-2 Failure and remedy
22-2-1 Starter system
22-2-2 Alter nator system

22-1 Structure and function

22-1-1 Electric circuit diagram



22-2 Failure and remedy

22-2-1 Starter system

Failure	Cause	Remedy
Pinion does not come out even when the starter switch is pressed.	- Disconnection of the wire harness, loose connection of the battery or switch terminal. - Spline which engaged with the pinion of armature shaft is caught and the pinion cannot move. - Malfunction of the plunger of magnetic switch, disconnection or the short-circuit of coil	Reconnect and tighten connections. Free the spline Correct or replace
Starter does not rotate even when the pinion engages with the ring gear.	- Disconnection of the cable between the battery and the magnetic switch, loosening (bad earth) of the connecting wire between magnetic switch and motor terminals - Improper engagement of pinion and ring gear - Wrong installation - Brush is worn out or brush spring is touching. - Commutator is dirty. - Malfunction of armature or field coil - Loosening of field coil and brush - Loose connection of contractor - Contact surface of contractor is rough.	Reconnect cable, tighten connections (make good earth). Correct the engagement. Reinstall Replace or adjust. Clean commutator. Correct or replace Tighten coil and brush. Tighten connections. Correct or replace
Starter rotates at its full speed before the pinion engages with the ring gear.	- Wrong adjustment of plunger gap (distance l) - Permanent set of pinion sleeve spring.	Adjust Replace
Engine does not start even when the pinion engages with the ring gear and the starter rotates.	- Malfunction of overrun clutch	Replace
Starter does not stop even when starter switch is turned off.	- Short-circuit inside switch - Contractor drops and is always connected.	Replace switch Replace

22-2-2 Alternator system

Failure	Cause	Remedy
Cannot be charged.	- Cords between terminals are disconnected or connectors are in loose connection. - Improper earth conection - Brush and slip ring do not contact. - Coil is disconnected or burnt. - Diode is damaged.	Reconnect cord-tighten connections. Make good earth conections. Connect or replace Replace Replace
Insufficient charge	- Loose connection of cords between each terminal - Fan belt slips. - Improper contact or insufficient movement of brush and slip ring - Short-circuit of coil - Defective diode	Tighten connections. Adjust. Clean slip ring and brush holder. Replace Replace
Overcharge	- Defective alternator	Replace
Noise	- Wrong installation - Defective fan belt - Defective bearing	Connect. Replace. Replace.
Fuse melts.	- Diodes on (+) and (-) sides broke down. - Capacitor broke down. - Alternator internal short-circuited	Replace.

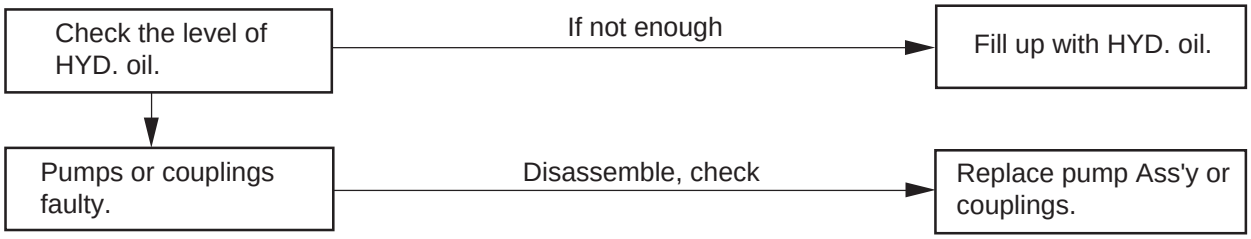
23 TROUBLESHOOTING

CONTENTS

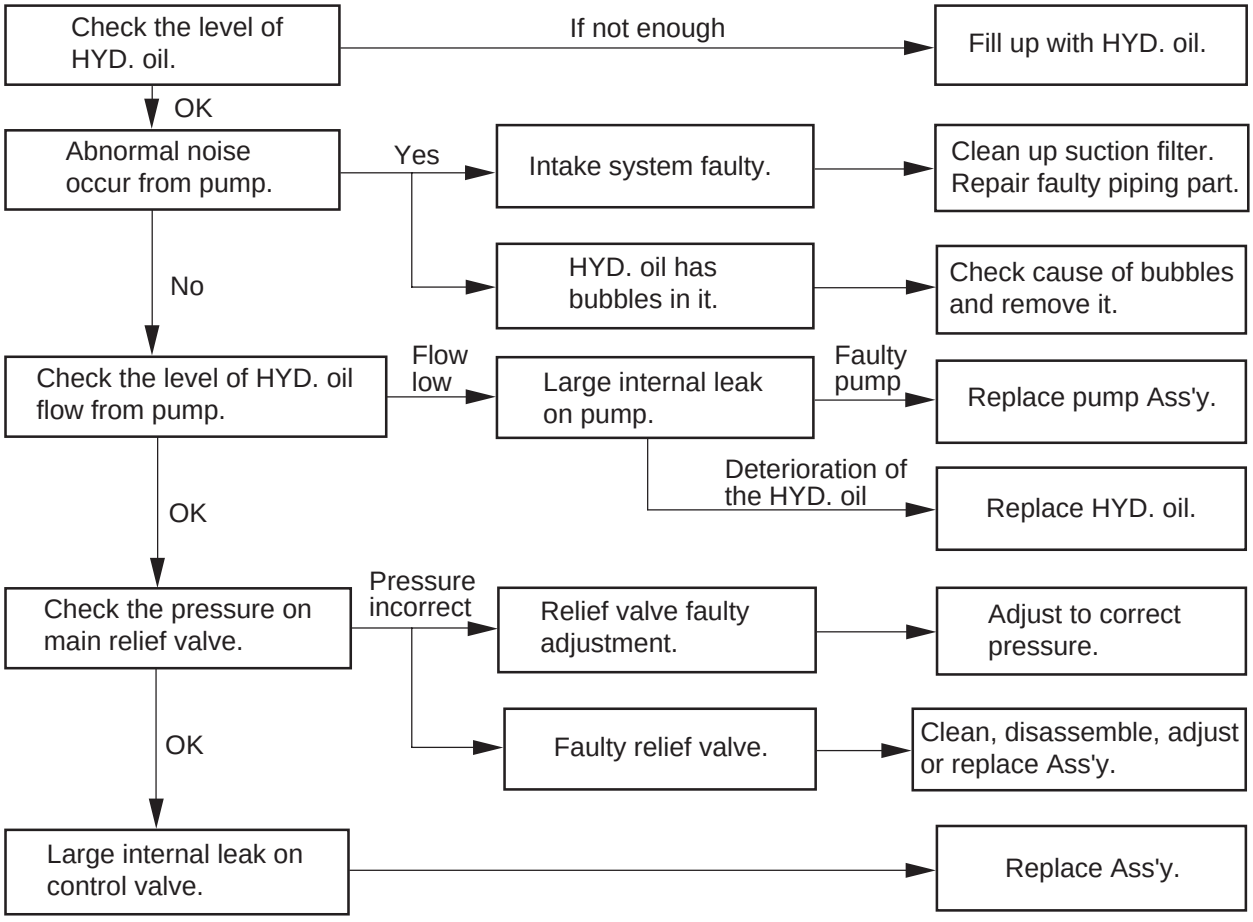
23-1 Troubleshooting

23-1 Troubleshooting

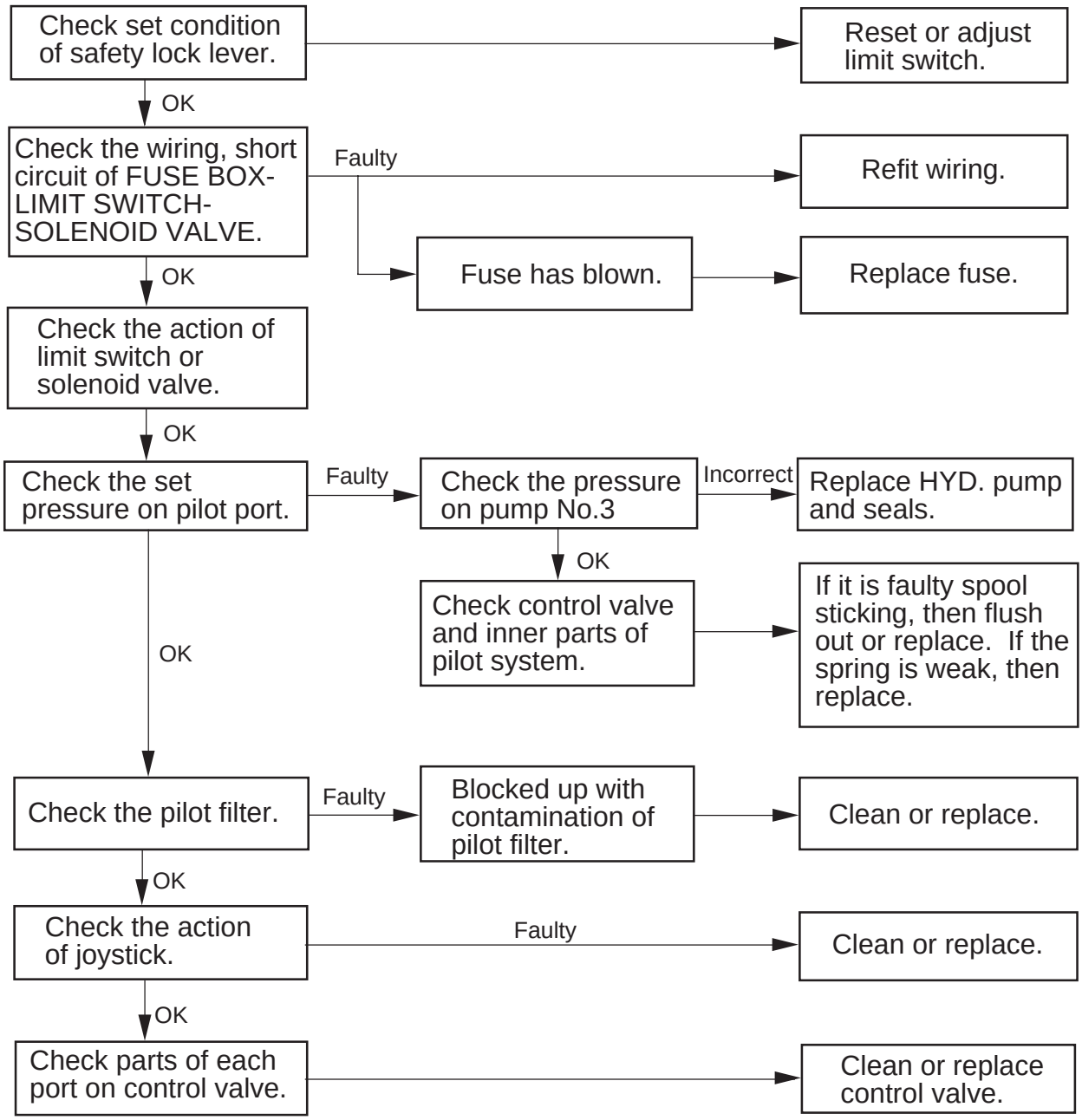
23-1-1 All functions not operational



23-1-2 Operation power is weak

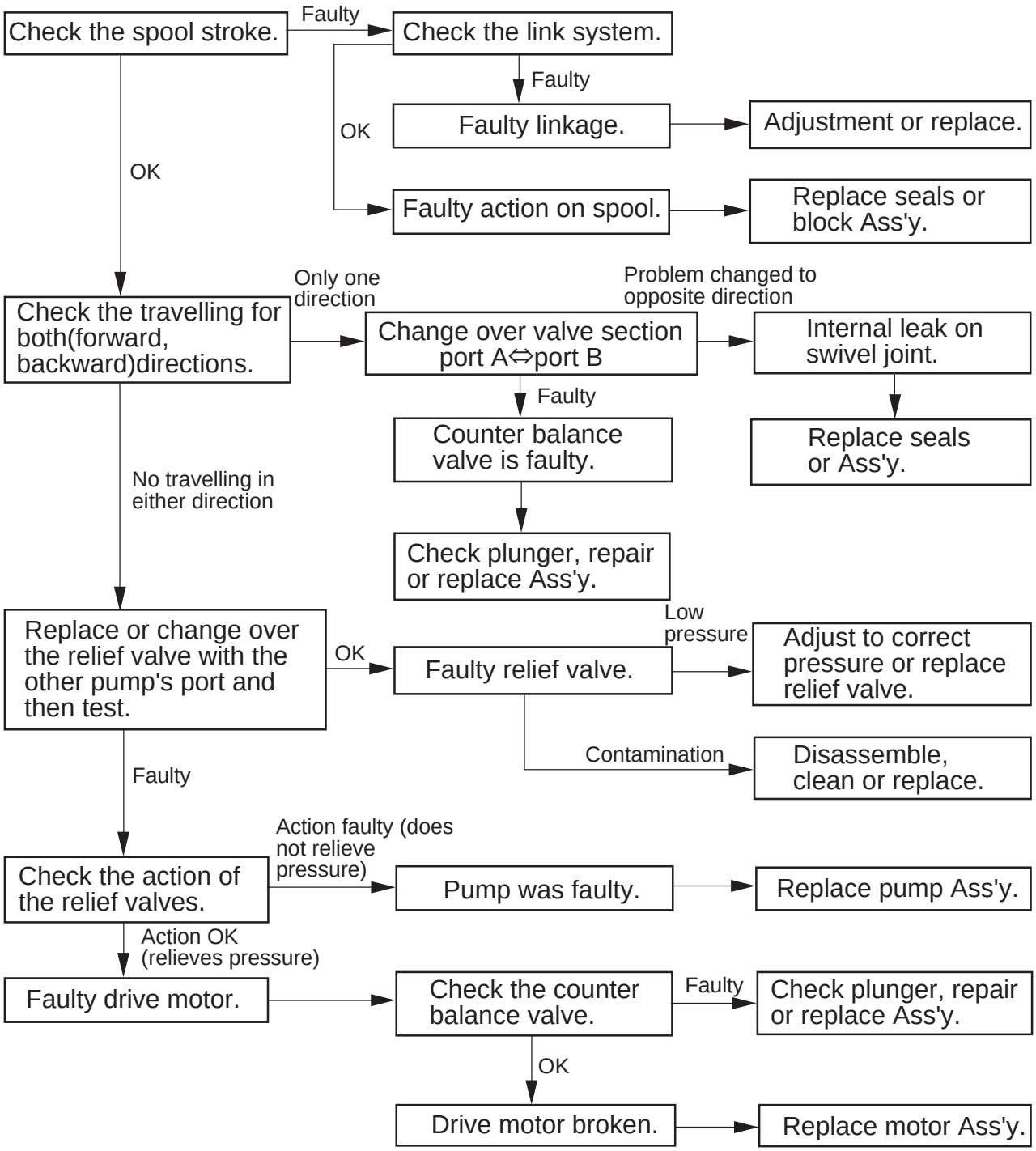


23-1-3 No operation on boom, arm, bucket & slewing

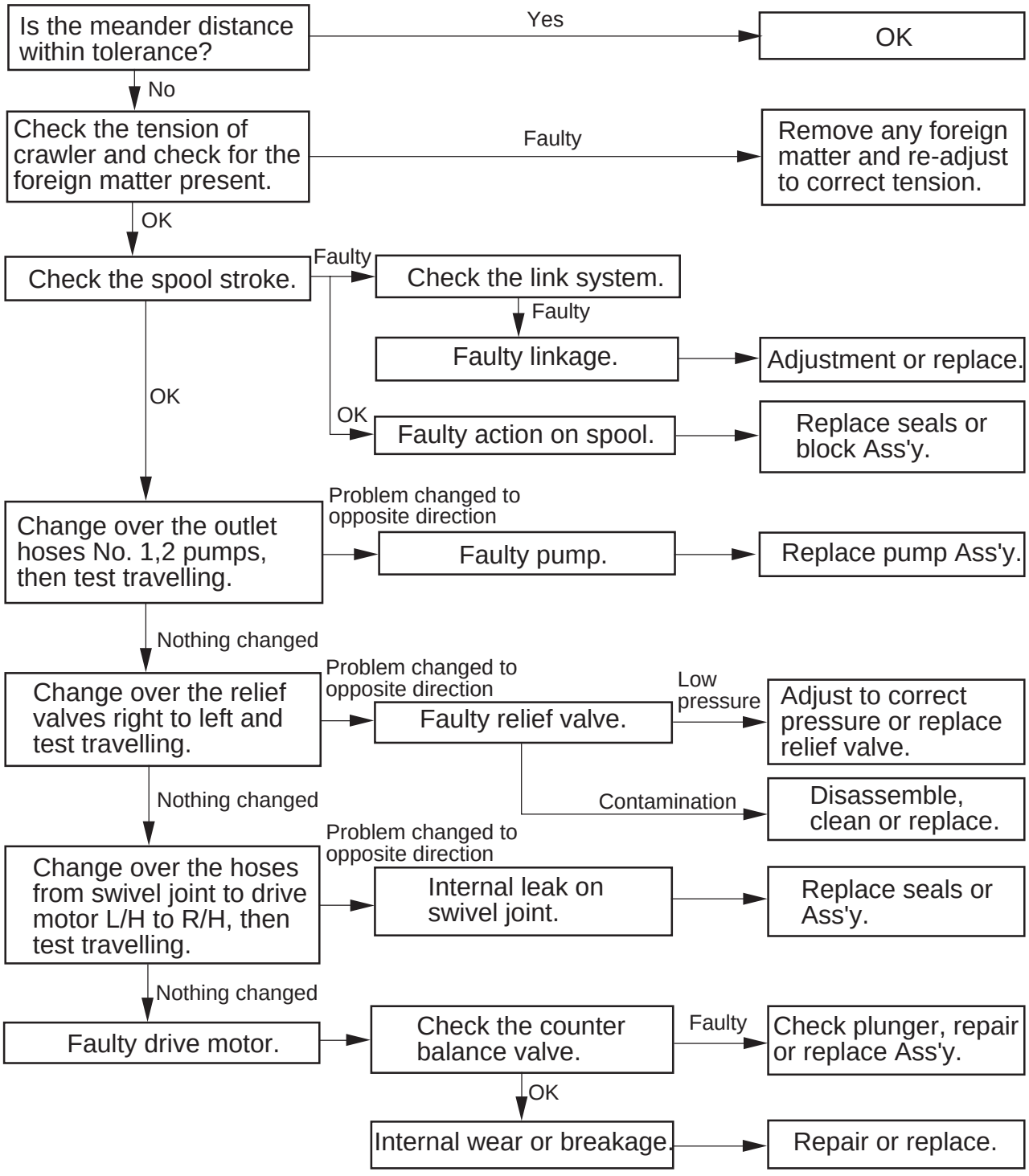


23-2 Travelling system

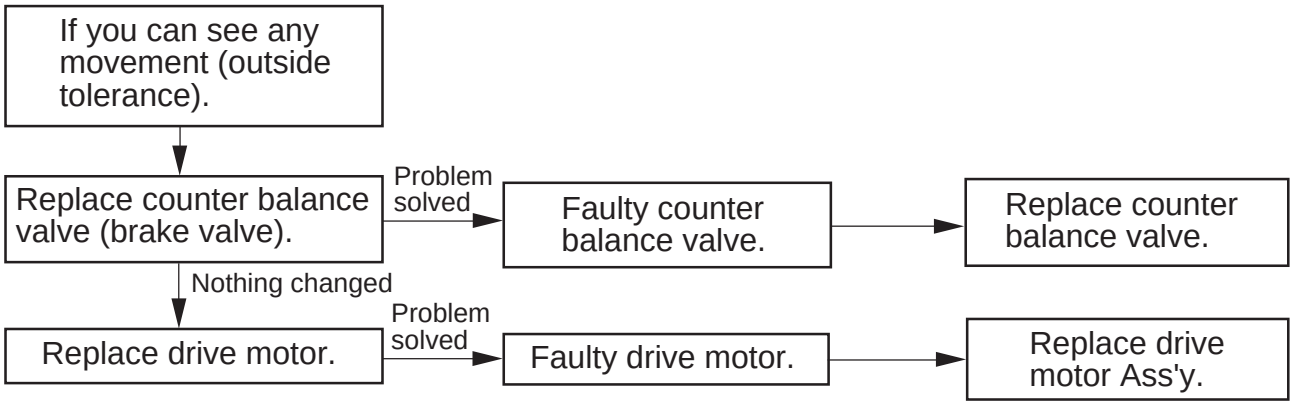
23-2-1 Right (or left) hand side of crawler does not work correctly



23-2-2 Travelling meander by slow speed on only right (left) hand side.

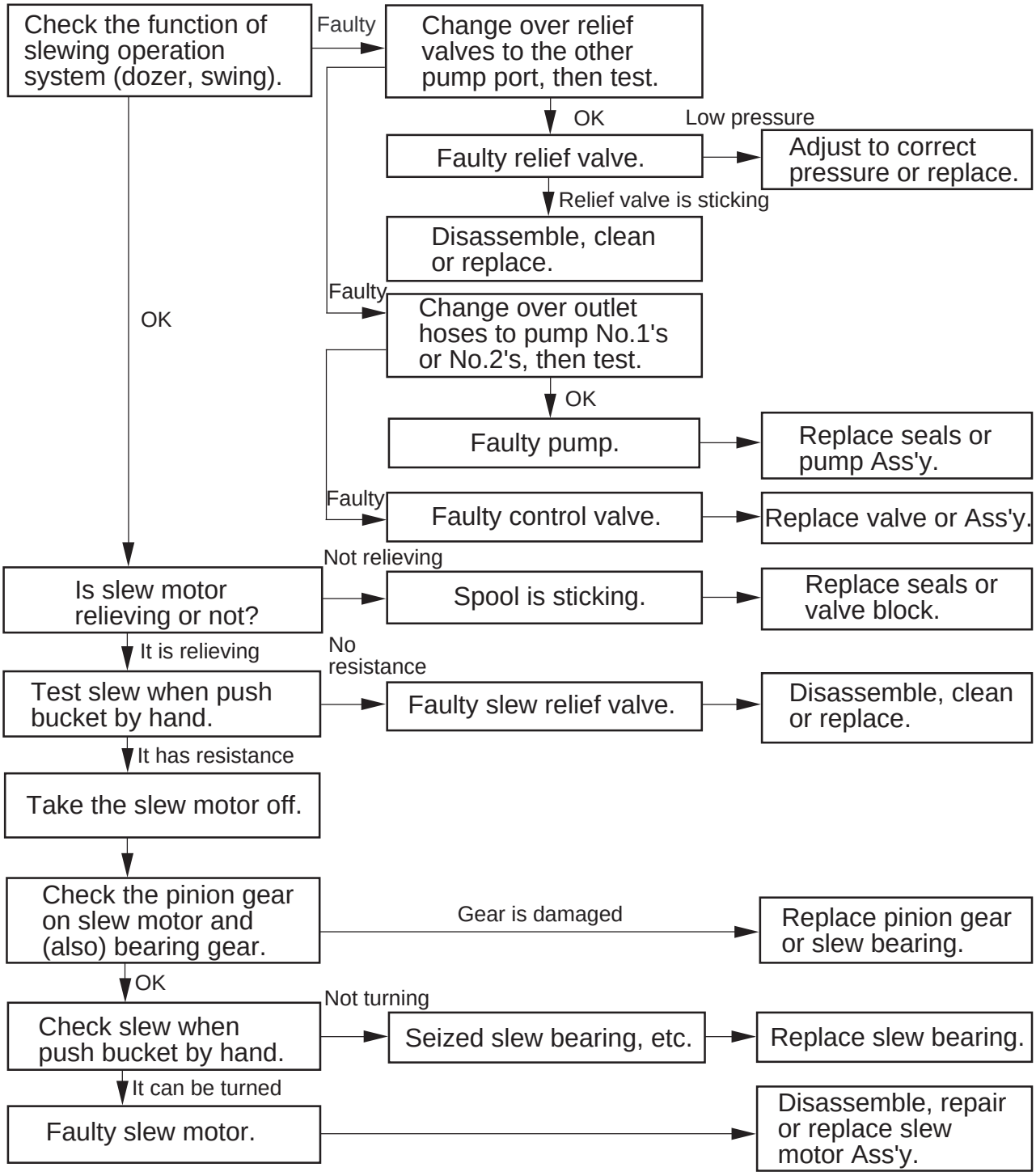


23-2-3 Machine fails to hold on incline

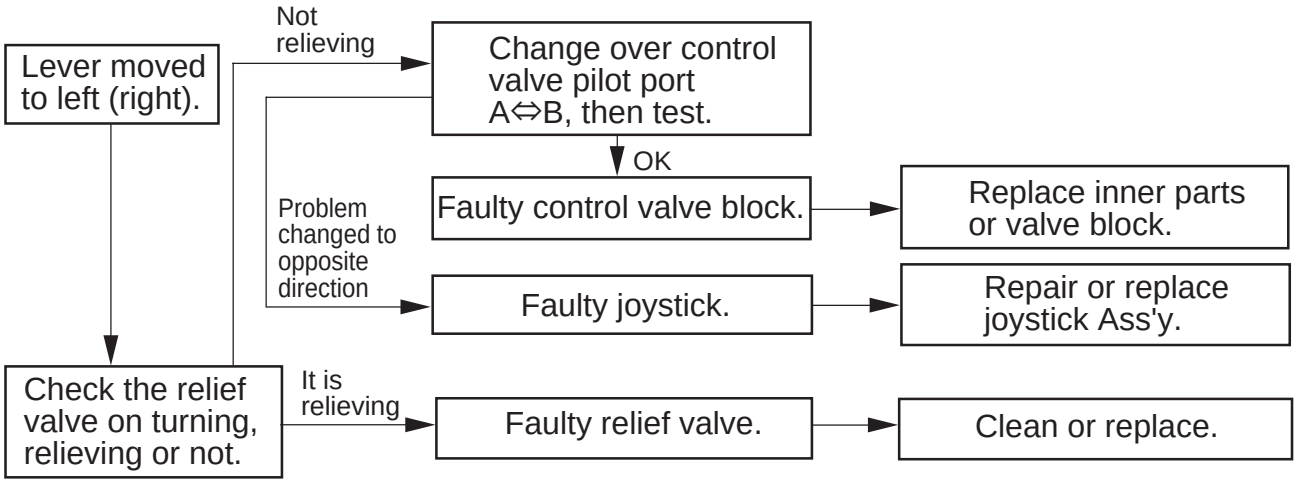


23-3 Slewing system

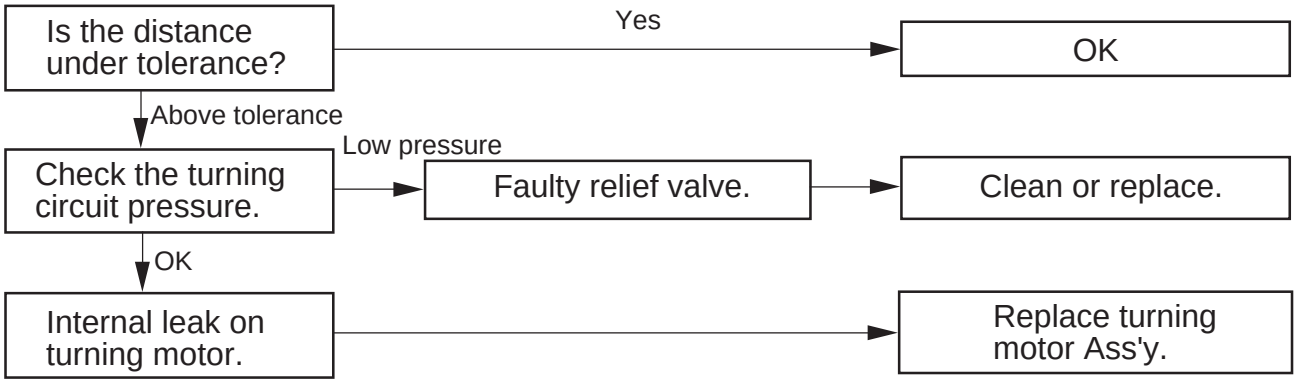
23-3-1 No operation both (right/left) slewing.



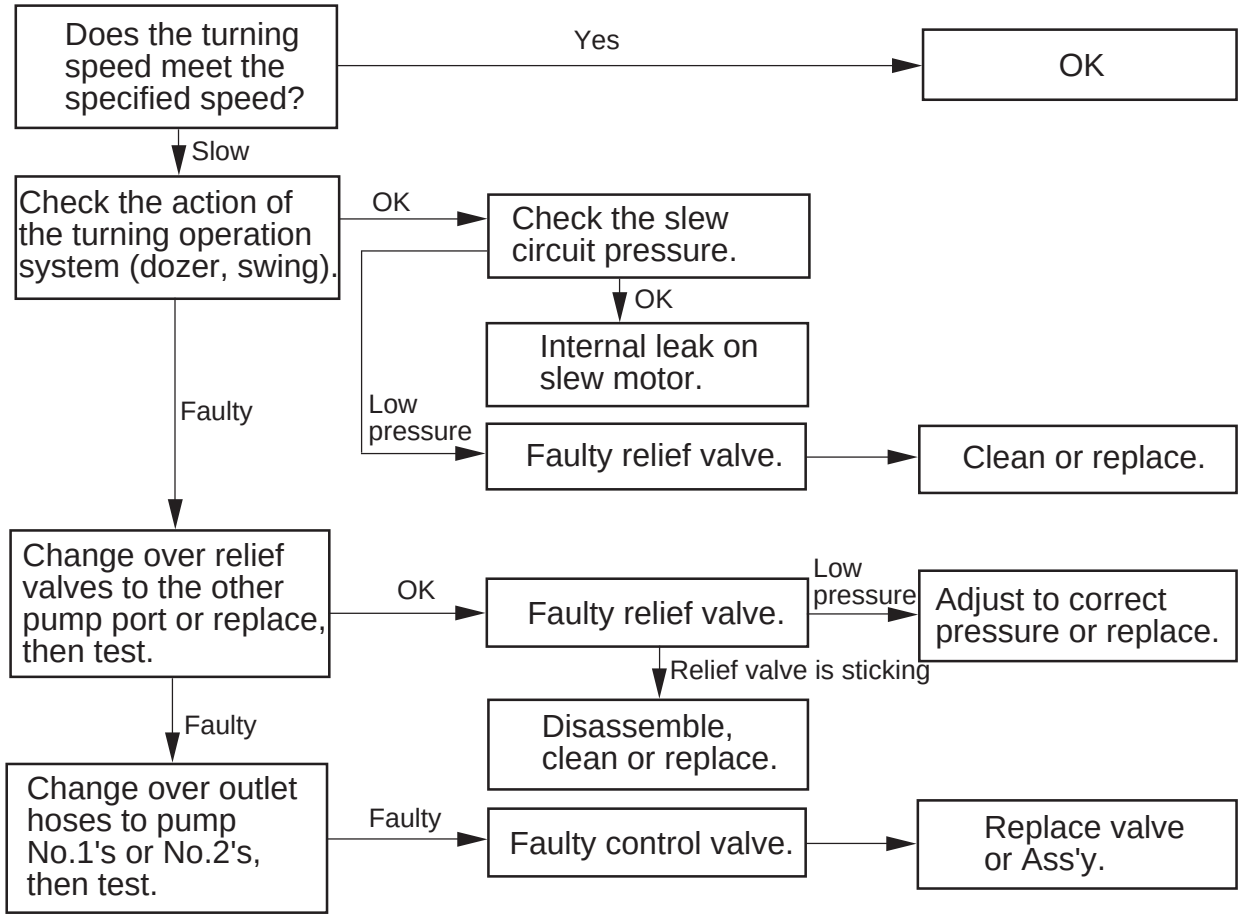
23-3-2 It is possible to turn right (left) but not left (right)



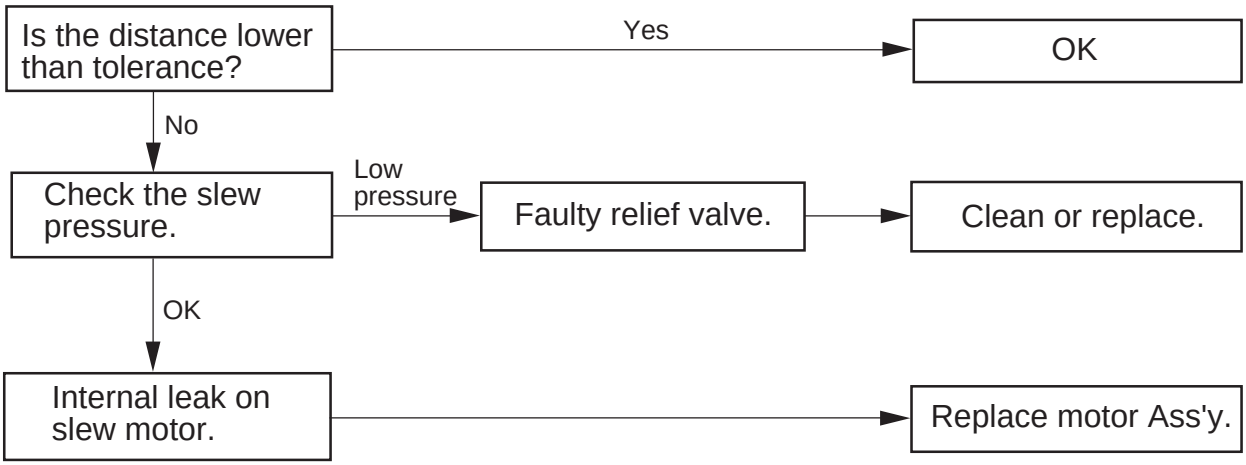
23-3-3 Turning acceleration slow, the overturn is higher than tolerance



23-3-4 Extreme slow slew speed

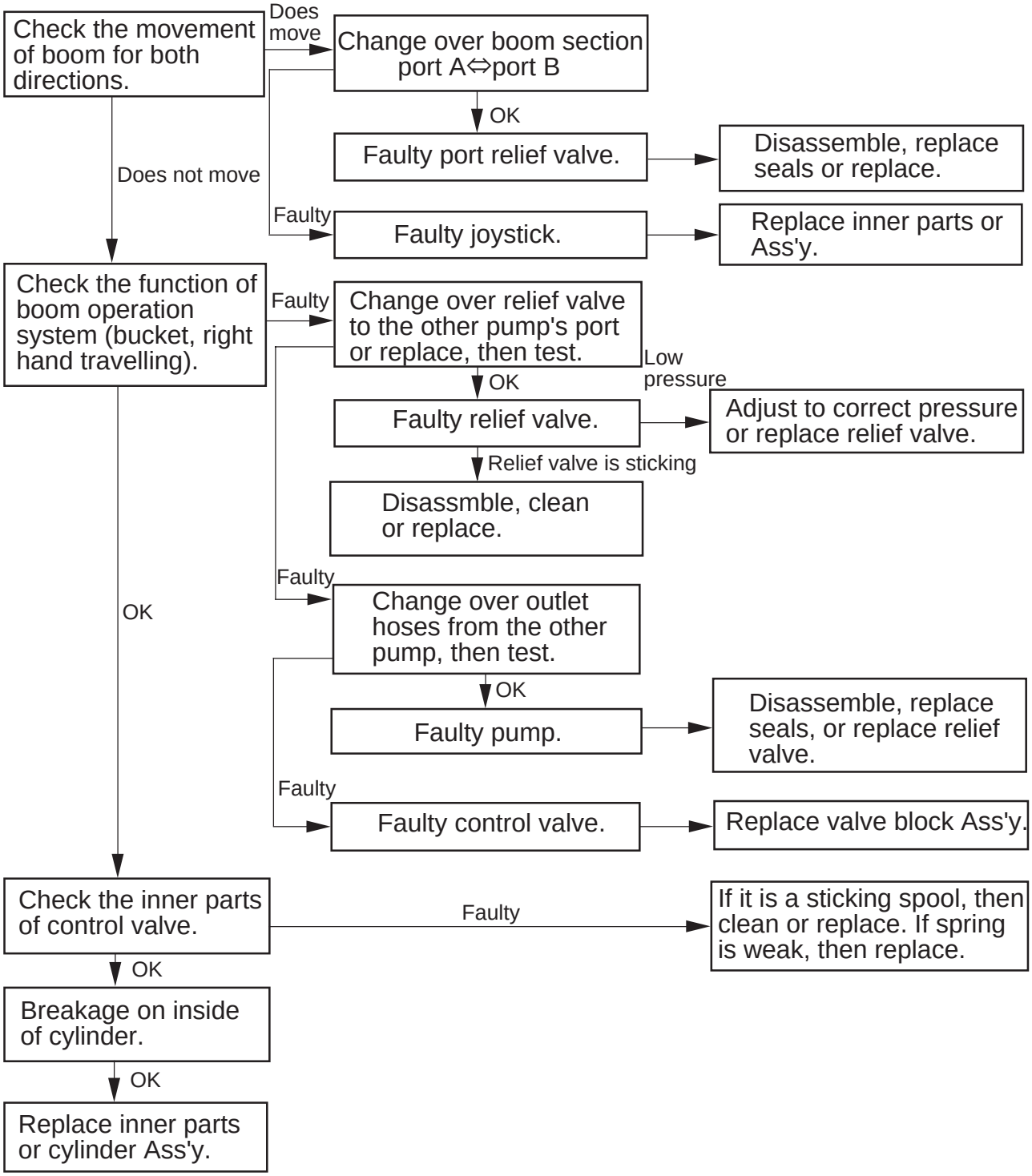


23-3-5 Turning movement when the machine is parked on a slope

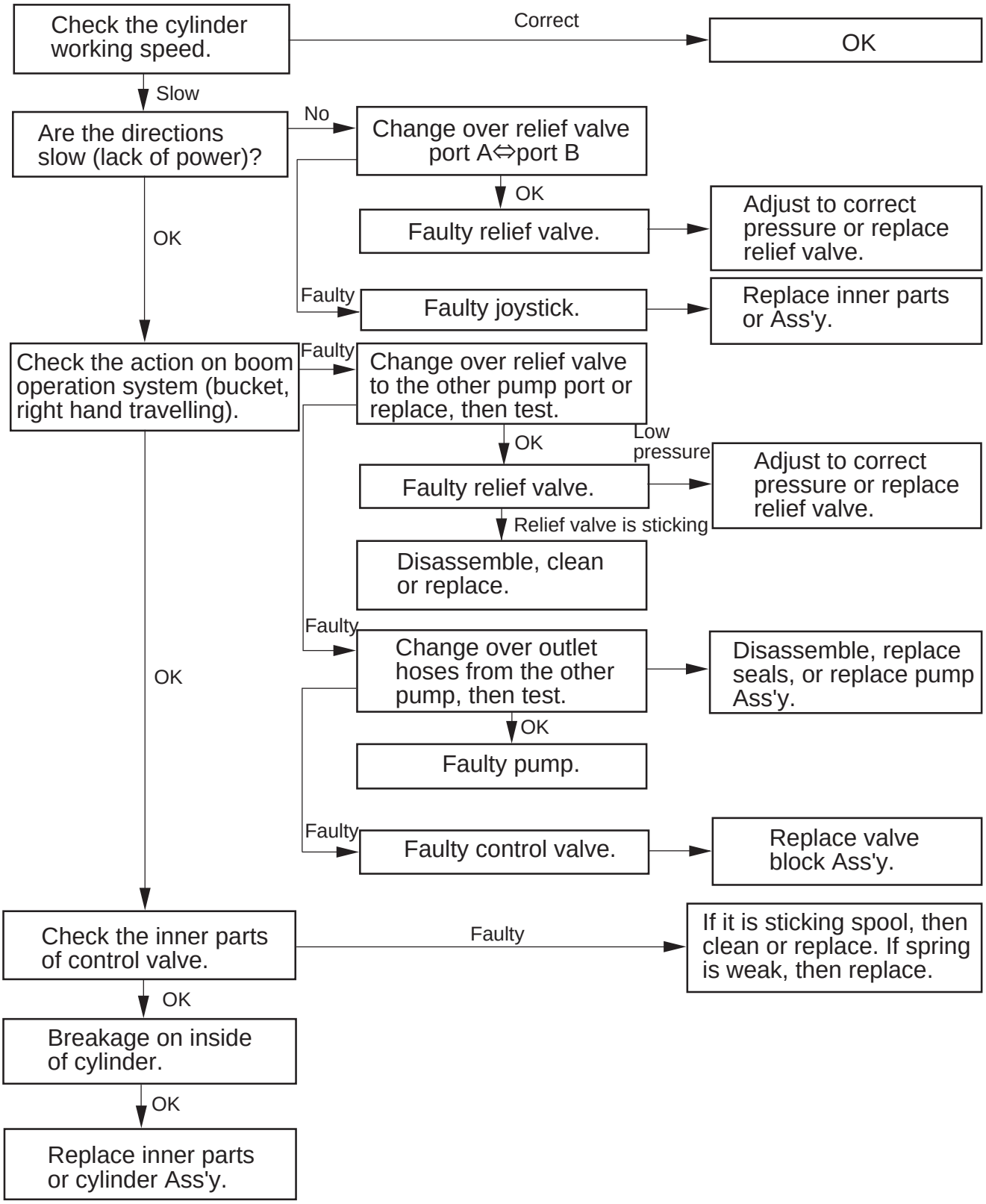


23-4 Boom system(for arm and bucket cylinders the same method as follows)

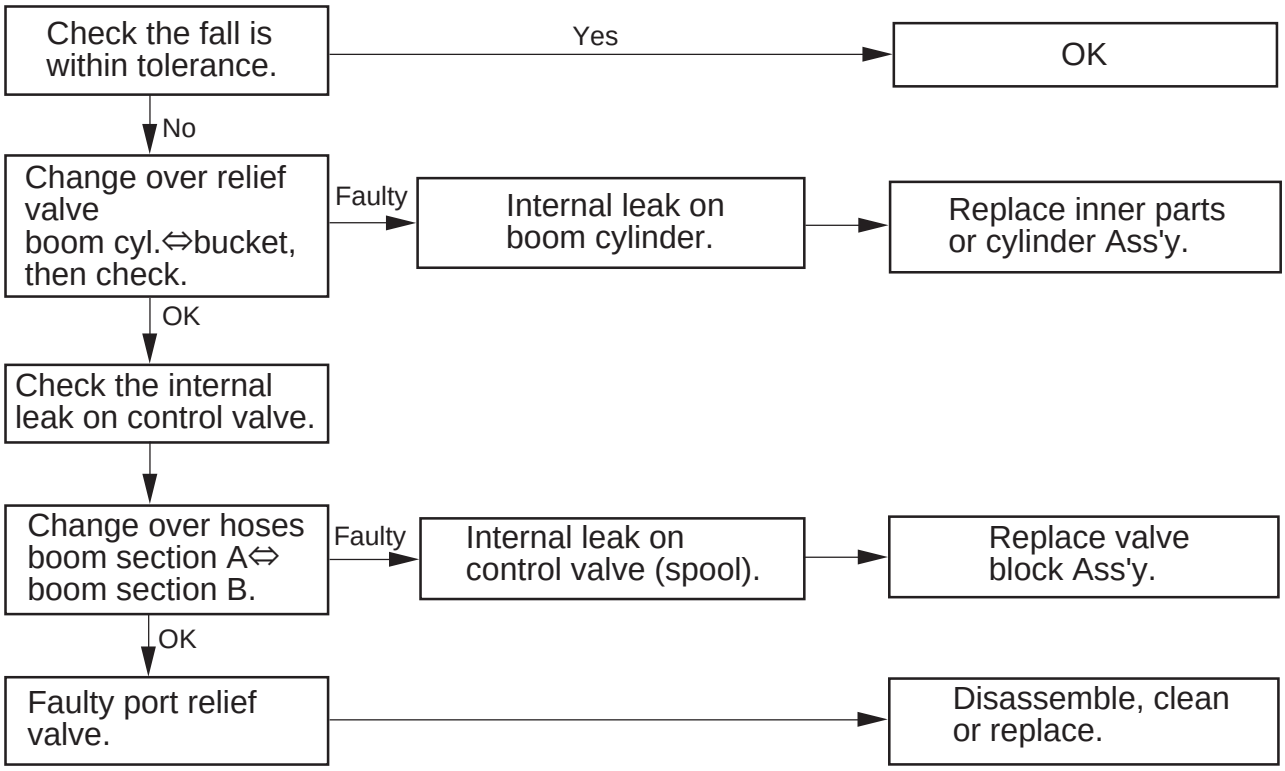
23-4-1 No movement on boom cylinder



23-4-2 Slow action or lack of power on boom cylinder

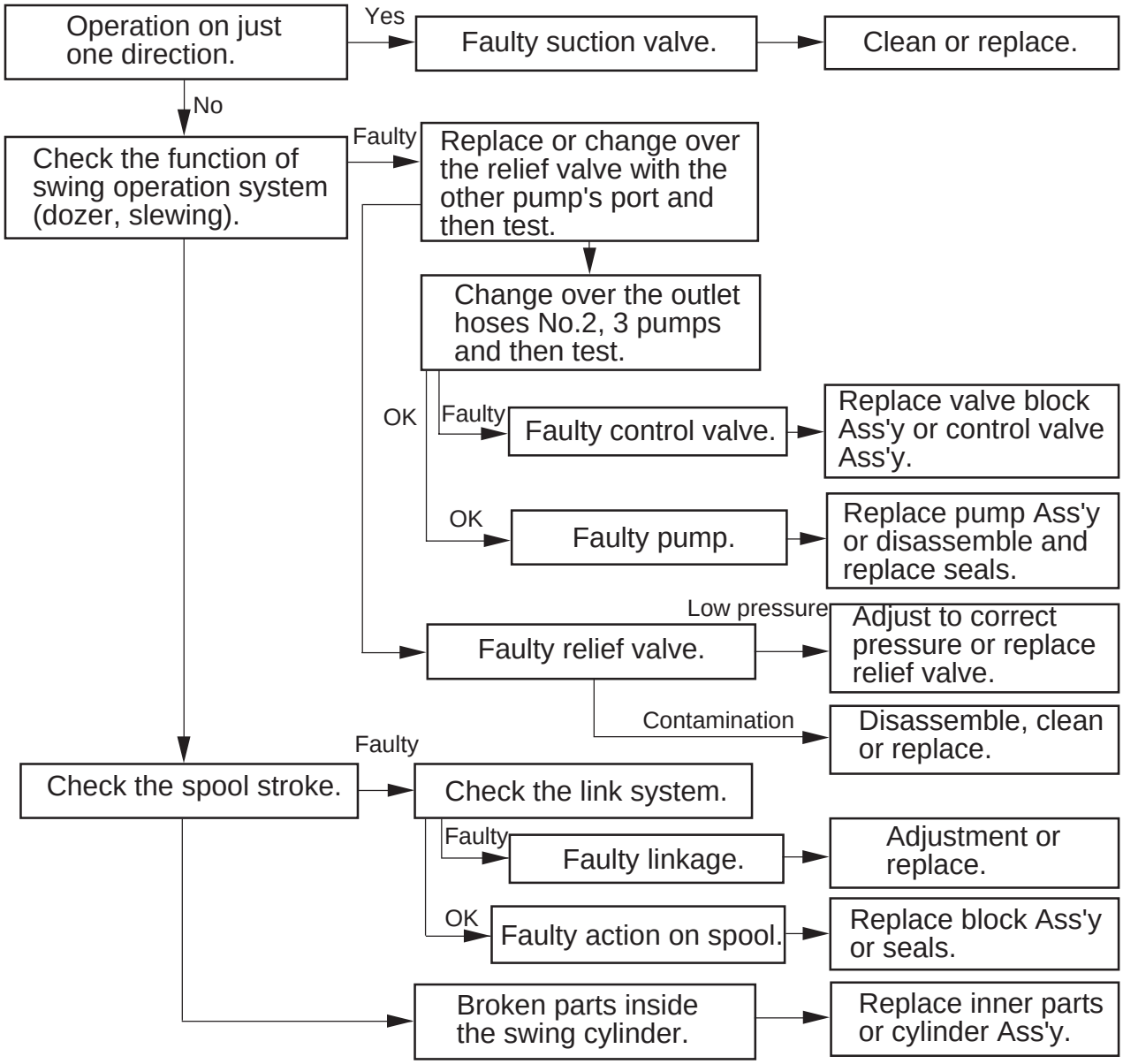


23-4-3 Natural fall of boom



23-5 Swing system

23-5-1 No movement on swing system



23-5-2 Drifting swing cylinder

